

THE MAMMALS OF CHINA AND MONGOLIA

PART 2

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THE MAMMALS OF CHINA AND MONGOLIA

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*With 41 Distribution Maps and 11 other Illustrations in the Text
and with 11 Plates*

NATURAL HISTORY OF CENTRAL ASIA

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**THE MAMMALS OF CHINA
AND MONGOLIA**



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NATURAL HISTORY OF CENTRAL ASIA SERIES
MAMMALS OF CHINA AND MONGOLIA Volume XI, Parts 1 and 2
by
DR. GLOVER M. ALLEN

CORRIGENDA

- Page xxv, Plate VII, Lower figure, to read: The hay-pile of a Mouse-hare (*Ochotona dauurica dauurica*) at Artsa Bogdo, in the Gobi.
- Page 3, 9th line from bottom: For *Cervus reevesii*, read *Cervus reevesi*.
- Page 4, 10th line from bottom: For *Mus huang-thomæ*, read *Mus ouang-thomæ*.
- Page 12, line 5: For *Citellus dauuricus mongolicus*, read *Citellus dauricus mongolicus*.
- Page 12, line 13: For *Microtus brandti*, read *Microtus brandtii*.
- Page 12, line 13: For *M. poliakoffi*, read *M. poljakowi*.
- Page 12, line 15: For *Cricetiscus songarus campbelli*, read *Cricetiscus sungorus campbelli*.
- Page 13, line 1: For *Felis bieti*=*pallida*, read *Felis pallida*=*bieti*.
- Page 14, 17th line from bottom: For *M. psammophilus*, read *M. meridianus psammophilus*.
- Page 15, 14th line from bottom: For *M. alpina*, read *M. altaica*.
- Page 15, 3rd line from bottom: For *Muntiacus reevesii*, read *Muntiacus reevesi*.
- Page 16, line 1: for *Cervus nippon boschi*, read *Cervus nippon kopschi*.
- Page 16, line 6: For *R. bowersi*, read *R. bowersii*.
- Page 18, 13th line from bottom: For *Petaurista hainana*, read *Petaurista hainanus*, and for *P. yunnanensis*, read *P. yunanensis*.
- Page 18, 6th line from bottom: For *Muntiacus vaginalis muntjak*, read *Muntiacus muntjak vaginalis*, and for *M. v. nigripes*, read *M. m. nigripes*.
- Plate VII, opposite page 46, legend to lower figure to read: The hay-pile of a Mouse-hare (*Ochotona dauurica dauurica*) at Artsa Bogdo, in the Gobi.
- Page 53, 19th line from bottom: For *Hemiechinus dealbatus alaschanicus*, read *Hemiechinus dauuricus alaschanicus*.
- Page 75, 2nd line from bottom: Chihfeng is in the province of Jehol.
- Page 117, 15th line from bottom: For *cylindricauda*, read *quadraticauda*.
- Page 141, 7th line from bottom: For *A. s. capito*, read *A. a. capito*.
- Page 279, 12th line from bottom: For lachrymalfo ramen, read lachrymal foramen.
- Page 365, in table: For 98.11.1.7 BM (type of *C. f. kuatunensis*), read 98.11.1.7 BM (type of *M. f. kuatunensis*).
- Page 388, line 9: For Chihfeng, northern Hopei, read Chihfeng, Jehol.
- Page 405, 7th line from bottom: For *A. albogularis*, read *M. albogularis*.
- Page 540, 21st line from bottom: For *Ochotona cansus stevensi*, read *Ochotona cansa stevensi*.
- Page 542, 8th line from bottom: For *Ochotona roylei*, read *Lagomys roylei*.
- Page xxi (pt. 2), bottom line: For 1, read 3.

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 Taipai Shan, Shensi 1256
- XVIII. Upper figure: Takin country in the Taipai Shan, Shensi.
 Lower figure: Sheep and Ibex haunts at Artsa Bogdo, Outer Mongolia . . . 1262
- XIX.—Upper figure: Sheep country near Kweihwacheng, northern Shansi.
 Lower figure: Darwin's Sheep or Argali (*Ovis ammon darvini*), killed in northern
 Shansi 1266
- XX.—Wild Asses (*Equus hemionus hemionus*) in the Gobi, near Tsagan Nor . . 1284

THE MAMMALS OF CHINA AND MONGOLIA

SECTION IV

**SYSTEMATIC ACCOUNT OF
THE MAMMALS OF CHINA AND MONGOLIA**

(Continued from Part I, Section II)

SECTION IV

SYSTEMATIC ACCOUNT OF THE MAMMALS OF CHINA AND MONGOLIA

(Continued from Part I, Section II)

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CHAPTER XIII

ORDER RODENTIA (Continued)

SUBORDER SIMPLICIDENTATA

TYPICAL RODENTS

THIS suborder comprises all the rodents with but one pair of upper incisors. In contrast to the Duplicidentata, the number of living families is large and their structure and adaptations diverse. In older classifications it was customary to recognize three main lines or groups of simplicidentate rodents: the sciuiromorphs, or squirrel-like species, with the anterior root of the jugal forming the fore part of the zygomatic arch and widely articulating with the maxillary at the anterior side of the orbits; the myomorphs, or mouse- and rat-like species, in which the jugal plays a smaller part in the formation of the middle portion of the arch only, resting anteriorly upon a backward extension of the maxillary; and the hystricomorphs, or porcupines and their allies, in which the jugal forms the center block of the zygomatic arch. A more recent classification by Miller and Gidley recognizes five different lines of development in accordance with the problems to be met in increasing the efficiency of the incisor and grinding teeth. These five lines are regarded as superfamilies, namely: Sciuroidea (squirrel kin), Myoidea (rats and mice), Dipodoidea (including the dormice, jumping mice), Bathyergoidea (including the African mole-rats), and the Hystricoidea (octodonts, porcupines). All but the fourth of these groups are represented in the Chinese fauna, although the fifth is limited in this area to the porcupines only. In the following list the order is that proposed by the two authors mentioned, although it may be that future study will slightly modify the conclusions reached.

SUPERFAMILY SCIUROIDEA

SQUIRREL-LIKE MAMMALS

In the squirrels and their allies the infra-orbital foramen is small and inferior to the orbit, transmitting a nerve only. "Zygomatic plate tilted upward, usually broad, with its superior border always above lower margin of infraorbital foramen" (Miller and Gidley).

Two families of this group occur in Asia: the Sciuridæ, containing the squirrels, and the Castoridæ, or beavers.

Family SCIURIDÆ

SQUIRRELS AND MARMOTS

This family contains both arboreal and ground-living or burrowing forms, but even in the latter the skull is but slightly modified for underground life. The frontal has a well-developed postorbital process; the infra-orbital foramen has its outer wall usually though not always forming a distinct canal, its orifice protected by a bony outgrowth to which the outer portion of the lateral masseter muscle is attached. The cheek teeth are usually short-crowned and simple in pattern, with the fundamental cusp arrangement usually evident. The following key includes the ten genera found in China and Mongolia.

KEY TO GENERA OF CHINESE AND MONGOLIAN SCIURIDÆ

- A. Tail length considerably more than half the length of head and body.
 - a. Size medium or small, less than 250 mm. in head and body length.
 - a'. Size medium, head and body more than 190 mm.
 - a''. Upper cheek teeth five, including the minute anterior premolar.
 - 1. Ears with pronounced tufts; colors red, black, and white. *Sciurus*
 - 2. Ears untufted.
 - a. Rostrum of skull short and broad, the length of the nasals less than the interorbital distance; belly usually red or (*C. e. styani*) washed with buffy. *Callosciurus*
 - b. Rostrum long, the length of nasals exceeding the interorbital width.
 - (a) Brain case convex and rounded; under side of body, limbs or tail usually with some bright red mark *Dremomys*
 - (b) Brain case low, not prominently convex above; under side of body and limbs white or buffy *Sciurotamias*
 - b''. Upper cheek teeth four; a pale lateral line. *Rupestes*
 - b'. Size small, head and body less than 190 mm.; striped.
 - a''. Ears tufted black and white; brain case convex. *Tamias*
 - b''. Ears not tufted; brain case somewhat flattened. *Eutamias*
 - b. Size very large; head and body more than 250 mm. *Ratufa*
- B. Tail not more than half the length of head and body.
 - a. Size larger, form robust; skull flattened. *Marmota*
 - b. Size smaller, form slender; skull not so much flattened. *Citellus*

Genus *Sciurus* Linnæus

SQUIRRELS

Sciurus Linnæus, Syst. Nat., ed. 10, vol. 1, p. 63, 1758.

The type species of *Sciurus* is the common European squirrel, *S. vulgaris*,

that ranges across the northern evergreen forests from the British Isles and central Europe eastward to northern China. It is characterized by its typically arboreal form, with long tail, limbs of normal length, tufted ears, skull with the brain case globular and convex dorsally, the temporal ridges very weak, and not meeting at the occiput. The cheek teeth are five above and four below, but the first upper premolar is very small and stands as a mere spicule in the middle of the tooth row and against the anterior side of the second or large premolar tooth. The other molariform teeth of the upper jaw are subequal in size, and are marked by two transverse ridges, except the last one, which has a single anterior ridge and a smooth basin-like heel. In profile view the three anterior teeth show three cusps each, with a minute cusplet in the valley between the second and third main cusps. The lower molariform teeth are nearly of the same size, with basin-shaped crowns. Whereas it is difficult to subdivide the tree squirrels into genera on the basis of skull and tooth characters, so similar are they in essential traits, it has nevertheless been shown by Thomas (1915a) that the characters of the baculum or penis bone offer remarkably constant and definite characters for the separation of some groups. In the genus *Sciurus* the baculum is of characteristic form, and is likened by Thomas to a spatula or a "half-closed human right hand, the shaft forming the forearm, the blade of the spatula the hollowed palm, and a small pointed projection on the right side corresponding to an outstretched thumb." Apparently but one species, represented by local forms of *Sciurus vulgaris*, occurs in Hopei and northern Mongolia, but it may be noted that a specimen purchased of a Chinese collector by Dr. F. R. Wulsin, and said to have come from Shansi, turns out to be *Sciurus lis*, and probably came instead from Japan. Nevertheless, the possibility of the species occurring on the mainland is not to be lost sight of.

259. *Sciurus vulgaris chiliensis* Sowerby

CHIHLI SQUIRREL

Sciurus vulgaris chiliensis Sowerby, Ann. Mag. Nat. Hist., ser. 9, vol. 7, p. 253, 1921.

Sciurus vulgaris Milne-Edwards, Recherches pour servir à l'Hist. Nat. des Mammifères, p. 307, 1868-74.

Sciurus vulgaris calotus Ognev, Zool. Anzeiger, vol. 83, p. 79, 1929.

Type specimen.—Skin and skull, No. 219185, U. S. National Museum, from the Eastern Tombs area, seventy-five miles northeast of Peiping, Hopei, China.

Description.—Although the color is variable, due to melanism that obscures the rufous to a greater or less extent, this squirrel may be distinguished among other species of eastern Asia by its prominent ear tufts which are longer and bushier in winter. In the latter season the pelage is pure dark gray, unless melanistic. In summer the general coloring is black on the body, limbs, and

tail, with more or less rufous ticking on the nape, back, and base of tail, while the central portion of the tail has the bases of the hairs ochraceous rufous. The cheeks are uniformly blue gray. Ear tufts black, more or less mixed with rufous. No eye-ring. The central portion of the under surface, including the lower throat, upper arms, and most of the inguinal region, is pure white to the roots of the hairs. Bordering the white area, a narrow strip along the flanks, the lower side of the forearms and of the hind legs is dark gray with rufous-tipped hairs in some; in others these parts are black. In specimens otherwise black the rufous tint may occasionally appear on the backs of the hind feet. The white of the lower side may, in some individuals, extend as a narrow line to the chin.

The skull has the frontal region nearly flat, the brain case full and rounded, with a distinct convexity to the upper profile. The postorbital processes are slender and depressed. The ridges of the temporal muscles form a somewhat lyrate outline on the back of the skull, but they do not meet posteriorly. The basicranial axis forms a considerable angle with the palate which has a small oval notch on each side just behind the last molar.

The anterior upper premolar is a very small spicule, about as large as the inner roots of the large premolar, and situated in the middle of the anterior border of that tooth. The four succeeding upper molariform teeth are of about equal size, each with two outer roots and one inner. As seen in side view, the two anterior teeth have each three cusps at the outer edge, the third has two and the fourth a single anterior cusp.

Measurements.—The following dimensions are shown by the series from the type locality collected by Dr. Roy C. Andrews.

No.	Head and body	Tail	Hind foot	Ear
56795	240	175	70	35
56797	240	188	68	34
56798	239	197	65	34
56799	220	193	65	34
56800	221	135	64	35
56801	215	185	62	33
56802	230	185	65	36

CRANIAL MEASUREMENTS OF *SCIURUS*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width outside molars	Upper cheek teeth	Lower cheek teeth	Locality
<i>S. vulgaris chiliensis</i>									
56998	52.7	45.6	27.2	31.6	24.7	12.7	9.7	9.6	Hopei
45297	53.9	46.6	28.8	32.4	24.2	13.6	9.6	9.5	Hopei
56795	53.2	46.9	28.1	32.5	25.4	12.6	9.1	9.6	Hopei
56797	53.8	46.5	28.4	32.1	25.0	13.0	11.6	9.5	Hopei
56799	52.9	46.0	27.7	32.6	24.9	12.8	9.6	9.6	Hopei

CRANIAL MEASUREMENTS OF *SCIURUS* (Cont'd)

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width outside molars	Upper cheek teeth	Lower cheek teeth	Locality
<i>S. vulgaris fusconigricans</i>									
45802	53.7	47.0	28.7	32.3	26.4	12.7	9.6	9.2	Mongolia
45803	52.3	44.8	27.6	30.3	23.7	12.8	9.8	8.8	Mongolia

Occurrence and Habits:—The Chihli Squirrel is confined to the timbered areas of that province (Hopei), but these are now more limited than even a few years ago, owing to the cutting off of the forests and the abandonment of the Imperial Hunting Grounds. Sowerby (1914) writes: "In North China the common squirrel is very rare, occurring only in the heavily forested regions. It has been recorded from the forests (now being demolished) of Northern Chihli. I have heard of it in West Shansi, but have never seen it there. It also occurs in Western Kansu and in Manchuria, in which two areas it is fairly plentiful. At one time it must have been very much more common in China proper, but like every other animal in this country, which is capable of being turned into money, has been so persecuted that it is very nearly extinct." The range is apparently nearly coëxtensive with the area of evergreen forest in the northern part of China, except that it seems not to extend around to the south side of the Mongolian deserts. As long ago as 1868 Père David secured it in the vicinity of Peiping, but I have found no records of it from south or west of that point, in spite of Sowerby's report of its supposed presence in Shansi. In Manchuria it is represented by *S. v. mantchuricus* of Thomas, which averages slightly larger in skull dimensions. Following along the forested area to the north of the Gobi, it enters the extreme northern edge of Mongolia in so similar a guise as to be questionably distinct, though the latest reviewer, Serebrennikov (1928), regards it as a geographic race, treated beyond.

Specimens examined:—In all, ten, from the Eastern Tombs, Hopei.

260. *Sciurus vulgaris fusconigricans* Dwigubski

Sciurus fusco-nigricans Dwigubski, Prodomus faunæ Rossicæ, Göttingen, p. 84, 1804.

Sciurus vulgaris fusconigricans Serebrennikov, Compt. Rend. Acad. Sci. URSS, 1928A, p. 423.

Type specimen:—The type, if such there was, is not known to be in existence, but the name was given to the squirrel from Bargusin, Transbaikalia, eastern Siberia.

Description:—The differences separating the squirrel of northeastern Transbaikalia and northern Mongolia from that of Hopei are not striking. In summer pelage the two are closely similar, but with, on the average, a slightly less tendency to show ticking of rufous in the blackish pelage. The skulls are

indistinguishable from those of *S. v. chiliensis*. Serebrennikov, in reviewing the Russian squirrels, maintains that this is a recognizable race, and it may eventually prove that the name will supplant those in use for the squirrel of Manchuria and North China. To the former Thomas has given the name *S. v. manchuricus*, claiming that its skull measurements average larger than in the Chinese race.

Measurements.—These are about the same as for the race *S. v. chiliensis*. A female from near Urga, Mongolia, measured: head and body, 240 mm.; tail, 160; hind foot, 65; ear, 35.

For skull measurements, see table under the preceding race.

Occurrence and Habits.—This is the squirrel that appears in the larch forest along the northern edge of the Gobi in Mongolia. Dr. Andrews secured a series from this one region, at distances from fifteen miles north and forty-five and sixty miles northeast of Urga. Its range, according to Serebrennikov, is the wooded parts of Transbaikalia and northern Mongolia from Lake Baikal and Kosso Gol eastward to the Khingan Range. Very likely *S. v. martensi* Matschie is not very different, as suggested by Thomas. The author previously quoted, however, regards it as a valid race, ranging from central Siberia eastward to the Syansk Mountains.

Specimens examined.—In all, ten, as follows:

Mongolia: fifteen miles north of Urga, 5; forty-five miles northeast of Urga, 2; sixty miles northeast of Urga, 3.

Genus *Callosciurus* Gray

RED-BELLIED SQUIRRELS

Callosciurus Gray, Ann. Mag. Nat. Hist., ser. 3, vol. 20, p. 277, 1867 (as a subgenus). Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 15, p. 385, 1915 (as a genus).

Baginia Gray, Ann. Mag. Nat. Hist., ser. 3, vol. 20, p. 279, 1867 (type, *Sciurus notatus*).

Erythrosciurus Gray, *ibid.*, p. 285 (type, *Sciurus ferrugineus*).

Heterosciurus Trouessart, Le Naturaliste, 2^{me} année, no. 37, p. 292, October 1, 1880 (type, *Sciurus ferrugineus*). *Sciurus* of authors.

Whereas the typical *Sciurus* in Asia is characteristic of the northern ever-green and mixed forests, the genus *Callosciurus* is oriental, found in the forests of southeastern Asia from the larger East Indies to Siam, India, and central China. In its general skull characters the squirrels of this group are not essentially different from *Sciurus*; the teeth are the same in number and structure, but are smaller; the brain case is slightly less full and globular, the frontal area is more depressed in the center, and the basicranial axis makes a flatter angle with the palate. The structure of the baculum is remarkable in that the bone is compound, consisting of two parts, a shaft and a sharp blade-shaped bone attached by ligament to it so as to be slightly movable on the shaft, with

which it articulates by a concave surface at its base. The blade projects laterally with the edge out. On the basis of these remarkable differences the genus is given full standing by Thomas. Its members may be distinguished externally from *Sciurus* by the lack of tufts on the ears and by the color pattern which usually includes a reddish belly, and no tendency to develop a striped pattern on the sides or back. The mammae are but four, abdominal, correlated with the few young usually born.

The type species is *Sciurus prevostii* Desmarest, of which *S. rafflesii*, the original type of the subgenus, is a synonym. This species is native to the Malay Peninsula, but Jentink (1883) has included it as Chinese on the authority of Gray. This in turn refers to Gray's *S. rufogularis* which is said by J. Anderson (1879, p. 268) to agree with the figure of *S. rafflesii* in the Zoological Journal (1828, vol. 4, pl. 4). Since later work has produced no evidence that this is a native of China, it may be dropped from consideration here. The same is true also of *S. plantani* (syn. *vittatus*) recorded by Jentink (1883) as represented in the Leiden Museum by two specimens from Canton, which, if the identification is correct, may have been purchased in the Market there. These presumably are the specimens first recorded from Canton by Müller

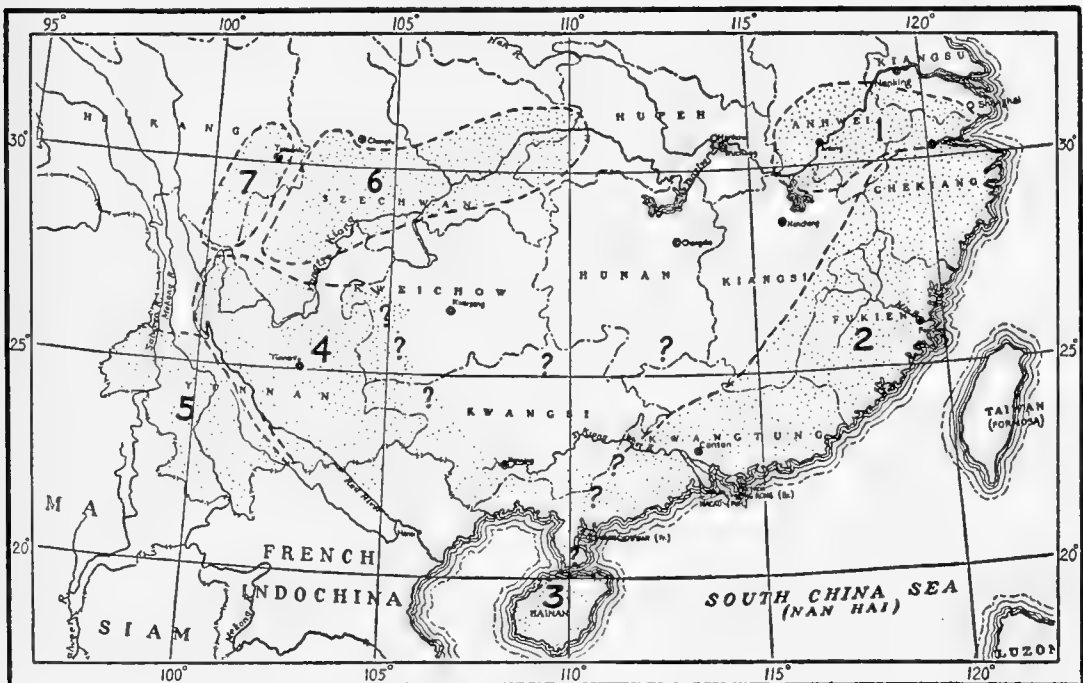


FIG. 24. Distribution Map.

Callosciurus

- | | | |
|------------------------------------|--|----------------------------------|
| 1. <i>C. erythræus styani</i> | 3. <i>C. erythræus castaneoventris</i> | 6. <i>C. erythræus bonhotiei</i> |
| 2. <i>C. erythræus ningpoensis</i> | 4. <i>C. erythræus michianus</i> | 7. <i>C. erythræus gloveri</i> |
| 5. <i>C. erythræus gordonii</i> | | |

and Schlegel in 1839-44 (Verhand. Natuurl. Gesch. Nederl. Bezitt., ed. Temminck) but may safely be regarded as not native. Jentink (1883) further records three adult males of *Sciurus atrodorsalis* in the Leiden Museum as from “?China,” but probably they came from Indo-China or some other point to the south of the Chinese boundaries. Eliminating these three, there are left two species known to occur within the Chinese boundaries. These include a rufous-bellied species widespread over southern China and breaking up into a number of local races, and a second, in which the belly is marked by black and white stripes, occurring in western Yunnan.

One other name remains to be considered, the *Sciurus chinensis* of Gray. This was applied to two mounted squirrels said to have been sent to the British Museum from “China” by J. Reeves. One of these, regarded as the type, has been made over into a skin, though the other is merely taken off the original stand. Bonhote found, on examining the skull, that the specimens belonged to the genus *Tomeutes* which as yet is not known to reach as far north as the southern borders of China. Hence it seems very likely that Reeves obtained the specimens elsewhere, or purchased them as captives, and supposed they were native to the country. The specimens, which I have examined at the British Museum, are apparently identical with *T. philippinensis*. They are dark brown above, with a narrow whitish eye-ring, white throat and ochraceous mid-belly.

KEY TO THE CHINESE FORMS OF *Callosciurus*

- A. Belly without black and white stripes, but a median mixed stripe often present; belly otherwise some shade of chestnut red or tinged with buff.
 - a. Tail tipped with white hairs; belly bright chestnut, with or without a median mixed stripe. *C. erythræus castaneiventris*
 - b. Tail tipped with ochraceous hairs.
 - a'. Ears colored like the rest of the head; mid-ventral stripe usually absent.
 - a''. Paler, sides and feet grayish.
 - 1. Belly orange red. *C. erythræus ningpoensis*
 - 2. Belly pale, grayish white, more or less tinged with buffy to ochraceous buff. . . . *C. erythræus styani*
 - b''. Darker, sides like the back, feet black. . . . *C. erythræus bonhotei*
 - b'. Ears more or less orange rufous, contrasting with the rest of the head.
 - a''. A mid-ventral mixed stripe usually present.
 - 1. Darker, dorsal surface evenly colored. . . *C. erythræus gordonii*
 - 2. Paler, mid-dorsal area darker than sides. . *C. erythræus michianus*
 - b''. No mid-ventral mixed stripe. *C. erythræus gloveri*

- B. Belly with a median and two lateral dark stripes separated by a white stripe.
- Lateral stripes black and distinct. *C. quinquestriatus quinquestriatus*
 - Lateral stripes indistinct, median one gray-mixed *C. quinquestriatus sylvester*

261. *Callosciurus erythræus castaneiventris* (Gray)

Sciurus castaneiventris Gray, Ann. Mag. Nat. Hist., ser. 1, vol. 10, p. 263, 1842.

Sciurus cinnamomeiventris Swinhoe, Proc. Zool. Soc. London, 1862, pp. 349, 357 (*lapsus calami*).

Sciurus castaneiventris Swinhoe, Proc. Zool. Soc. London, 1870, p. 231.

Sciurus erythræus insularis J. A. Allen, Bull. Amer. Mus. Nat. Hist., vol. 22, p. 473, 1906.

Callosciurus erythræus castaneiventris Robinson and Kloss, Records Indian Mus., vol. 15, p. 199, 1918.

Sciurus erythræus castaneiventris A. B. Howell, Proc. U. S. Nat. Mus., vol. 75, art. 1, p. 44, 1929 (in part).

Type specimen.—The type is an old skin in the British Museum sent by John R. Reeves about 1840. Although labeled "China," its exact locality is unknown, but was assumed by Thomas (Proc. Zool. Soc. London, 1925, p. 501) to be, as with Reeves's "other mammals, . . . the mainland of" southeastern China, "more or less in the region of Canton." Robinson and Kloss (1918) had previously recorded that specimens from Hainan agreed perfectly with the type, and had therefore regarded that island as the type locality, an opinion in which Osgood (1932) is inclined to concur. Specimens from Tongking are very similar, but apparently not identical. Hitherto no comparisons have been made with specimens known to come from the Canton region, and it seems extremely probable that, when this is done, it will be found that those from Hainan are inseparable from those of extreme southeastern continental China, which would bear out Thomas's conclusion.

Description.—In a large series of specimens from Hainan taken in December, the general color of the forehead, nape, back, arms, and legs is a uniform olivaceous, in which, amongst all-black hairs, are those with a grayish base, then two very small rings of pale ochraceous, separated by a minute black ring, and tipped with the same. This coloring is very uniform, hardly at all paler at the sides. On the cheeks, chin, and muzzle, the upper side of the forearms, and the wrists all around, the pale-ochraceous ring on the hairs becomes almost whitish, producing a grayish tint. On the throat this grayish tint extends as a narrow line on to the chest and in some cases is narrowly continued to the root of the tail. Usually the entire under side from the lower throat to the root of the tail, and the under side of the limbs to the wrists and ankles are clear, bright chestnut or ferruginous. The backs of the hands and the hind toes are darker, more blackish. The tail is like the back above and below, except that the much longer hairs have the ochraceous band correspondingly longer, with a tendency to formation of transverse alternating cross-stripes of black and ochraceous buff. At the terminal third of the tail, the

hairs are longer, with long whitish tips (sometimes buffy) and long black bases. Summer specimens are not noticeably different.

There is much variation in the details of coloring, particularly in the extent of the red on the under side. In some cases it may extend nearly to the lips, but usually leaves the chin and throat gray, and in exceptional cases this gray is continued as a mid-ventral line of mixed black and buff or black and gray.

Measurements.—The following external dimensions were taken in the flesh by the collector:

No.	Head and body	Tail	Hind foot	Ear	Locality
58056	225	195	52	21	Hainan
58094	210	185	49	22	Hainan
58084	215	188	53	20	Hainan
58100	210	180	44	21	Hainan
58103	200	180	46	22	Hainan
58081	220	205	52	21	Hainan
58082	223	175	50	20	Hainan
58086	210	205	55	18	Hainan

CRANIAL MEASUREMENTS OF *CALLOSCIURUS ERYTHRÆUS CASTANEOVENTRIS*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
58004	51.9	45.1	26.2	30.4	24.5	12.5	10.5	10.0	Hainan
58056	52.6	47.0	27.3	31.9	23.5	13.0	10.5	10.0	Hainan
58066	51.3	44.5	25.6	29.8	22.8	11.5	10.4	10.0	Hainan
58084	49.8	42.9	25.0	30.3	23.5	11.9	9.8	9.4	Hainan
58100	51.0	43.7	26.6	30.2	23.6	11.7	9.5	9.3	Hainan
58103	49.2	43.6	25.0	29.6	22.4	12.0	9.8	9.7	Hainan

Occurrence and Habits.—This race is common on Hainan, as recorded by various writers. It is probable also, as mentioned above, that the chestnut-bellied squirrels of the adjacent mainland are the same, and intergrade with the grayer race *C. e. ningpoensis* somewhere in southern Fukien, or northern Kwangtung. Mr. Clifford H. Pope, who collected a series in Hainan, writes that the Red-bellied Squirrel is plentiful in all the jungle patches about Nodoo as well as in the big woods to the south and west. One lived in the Mission compound during all one winter, and individuals were found in the larger hedges as well as in neighboring patches of bamboo and thickets. Although seldom seen on the ground, these animals are particularly common in the woods, and especially in early morning or just before dusk are actively feeding and may be heard calling. They are agile, making tremendous leaps, swinging from one branch to a bunch of leaves on the tip of another. After being much hunted, they become exceedingly shy and wary. Mell (1922) writes that in parts of Kwangtung with which he is familiar, this race does not occur, but is

occasionally seen in the Canton Market, brought from Hainan, thus giving color to the supposition of Robinson and Kloss that the type was received from Hainan in the same way. Shih (1930, p. 5) states that in the Yao Shan area of Kwangtung it does occur, but is less common than "*Sciurus rufigenis*."

Specimens examined.—The following one hundred and seven:

Hainan: Nodua, 99; Namfong, 8.

262. *Callosciurus erythræus ningpoensis* (Bonhote)

NINGPO SQUIRREL

Sciurus castaneiventris ningpoensis Bonhote, Ann. Mag. Nat. Hist., ser. 7, vol. 7, p. 163, 1901.

Sciurus castaneiventris De Winton and Styan, Proc. Zool. Soc. London, 1899, p. 577.

Sciurus tsinglanensis (sic) Hilzheimer, Zool. Anzeiger, vol. 29, p. 298, 1905.

Sciurus tsinglauensis Hilzheimer, Abh. u. Ber. Mus. f. Natur- u. Heimatk., Magdeburg, vol. 1, p. 172, 1906.

Heterosciurus ningpoensis Matschie, Wiss. Ergebn. d. Exped. Filchner nach China u. Tibet 1903-05, vol. 10, pt. 1, p. 230, 1908.

Callosciurus erythræus ningpoensis Robinson and Kloss, Records Indian Mus., vol. 15, p. 200, 1918.

Callosciurus erythræus castaneiventris G. M. Allen, Amer. Mus. Novitates, no. 163, p. 11, 1925 (in part).

Type specimen.—The type is a skin (?with skull), No. 86.10.28.3, British Museum, from the hills thirty miles from Ningpo, Chekiang, China. Collected in March, 1884, by F. W. Styan.

Description.—This race is much like *C. e. castaneiventris*, except that it is distinctly paler, the back with slightly less black, and the buffy band on the individual hairs more ochraceous, giving a warmer, slightly more orange or rufous tint. The backs of the feet are less mixed with black, the flanks are decidedly grayish, in contrast to the middle of the back, instead of being colored like it as in *C. e. castaneiventris*, while the red of the belly is a much more orange red than the deep chestnut of the latter. The tail is pale orange fringed instead of white-tipped.

Measurements.—In size this race may be a trifle smaller than that to the south, as the following measurements taken in the field indicate.

No.	Head and body	Tail	Hind foot	Ear	Locality
84504	210	170	47	22	Fukien
84506	202	183	46	23	Fukien
84507	203	165	45	21	Fukien
84512	200	160	46	22	Fukien
84514	205	165	45	22	Fukien
84516	215	180	48	21	Fukien
24262 MCZ	200	170	41	21	Chekiang
24261 MCZ	190	186	45	22.5	Chekiang
24263 MCZ	194	171	43	20	Chekiang
24265 MCZ	223	131	52.5	21	Chekiang
24260 MCZ	192.5	163	53	19.5	Chekiang

CRANIAL MEASUREMENTS OF *CALLOSCIURUS ERYTHREUS NINGPOENSIS*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
84502	50.3	43.0	25.3	30.0	24.0	12.0	10.3	10.0	Fukien
84503	49.5	41.6	24.5	28.7	23.2	12.0	10.3	10.0	Fukien
84505	51.0	43.0	24.7	30.4	23.0	12.0	10.2	10.0	Fukien
84507	52.0	44.0	25.5	31.0	24.5	12.5	11.0	10.5	Fukien
84508	51.0	44.0	25.6	32.0	24.0	12.7	10.3	9.7	Fukien
84547	50.0	43.2	25.1	30.3	24.5	13.0	10.8	10.3	Fukien
84549	53.0	45.0	25.7	31.8	24.8	12.4	10.5	10.2	Fukien
84552	52.0	45.8	26.3	31.7	25.0	12.8	10.5	10.0	Fukien
84554	52.5	43.3	24.4	30.0	23.5	12.5	10.5	10.0	Fukien
58340	50.4	42.8	24.4	29.7	23.5	12.0	10.3	9.6	Chekiang
24261 MCZ	50.0	43.0	24.6	28.9	21.7	12.1	9.5	9.0	Chekiang
24263 MCZ	48.6	41.6	23.6	28.2	22.0	12.2	10.5	10.0	Chekiang
24264 MCZ	49.5	41.8	23.5	28.7	22.6	11.6	10.2	9.9	Chekiang
24265 MCZ	48.8	40.1	23.6	29.9	22.8	12.3	9.8	10.0	Chekiang

Nomenclature.—Study of an ample series of these squirrels from Chekiang shows that they are practically identical with the series from Fukien that I had previously (1925a) referred to *C. e. castaneoventris*. The latter name is now restricted to the squirrel of Hainan, and probably the adjacent mainland of extreme southeastern China. The form from Fukien northward to the limit of the species' range on the coast is the present, distinguished by its much grayer sides and slightly paler-chestnut belly. As shown by Matschie (1908), Hiltzheimer's *Sciurus tsingtauensis* is a synonym of *C. e. ningpoensis*, the type having come from Nimrod Sound, a few miles from Ningpo, instead of from Tsingtao.

Occurrence and Habits.—According to De Winton and Styan (1899, p. 577), this is a common squirrel of the mountains of Fukien and Chekiang, but does not extend its range on to the plains adjacent. They mention a "large colony" in a hillside hollow on rocky ledges, and in small firs, where two score or more were seen. There appears to be no essential difference between the fine series from Tunglu, Chekiang, collected by Mr. J. T. Wright, and those obtained by Mr. Clifford H. Pope in the mountains of northern Fukien, although occasional specimens from the latter lot are perhaps a trifle more buffy and less gray on the sides. Beneath, their more orange-red coloring is in contrast to the deep chestnut of *C. e. castaneoventris* of Hainan. Mr. Pope writes that this race "is abundant in tangled ravines and wooded hillsides of Futsinghsien. It is generally arboreal in habits but may also be found frequenting rock walls and very low scrub growth. At Kuatun this species was rare." An adult female taken at Futsing, August 2, 1916, contained two embryos, a small

litter, correlated perhaps with the small number of mammæ which are but four, inguinal; at Tunglu, Chekiang, a small young, perhaps two weeks old, was taken August 22.

Inland from the coastal hills of Fukien, this race seems to give way to the pale-bellied *C. e. styani*, and intergradation is seen in an occasional individual approaching this type, even in Chekiang. The series from Tunglu, south of the mouth of the Yangtze, must mark nearly the northward limit of the range, and is quite uniform in its gray sides and orange-red belly, without the gray median line. Two of the specimens from Tunglu, Chekiang, are so pale beneath as to be almost like *C. e. styani*, with the entire belly washed with ochraceous buff instead of chestnut. Other specimens from the same province are even paler, and there is every gradation between the chestnut-bellied specimens of the usual coastal type and those with the washed-out lower surface typical of the inland plains.

Specimens examined.—In all, ninety, as follows:

Chekiang: Ningpo, 11; Tunglu, 11 (M.C.Z.).

Fukien: Chunganhsien, 4; Futsing, 53; Yenping, 11.

263. *Callosciurus erythræus styani* (Thomas)

Sciurus styani Thomas, Ann. Mag. Nat. Hist., ser. 6, vol. 13, p. 363, 1894.

Macroxus griseopectus Milne-Edwards, Recherches pour servir à l'Hist. Nat. des Mammifères, p. 305, 1868-74.

Sciurus griseipectus Swinhoe, Proc. Zool. Soc. London, 1870, p. 634 (not of Blyth).

Herpestes leucurus Hilzheimer, Zool. Anzeiger, vol. 29, p. 299, 1905.

Herpestes albifer Hilzheimer, Abh. u. Ber. Mus. f. Natur- u. Heimatk., Magdeburg, vol. 1, p. 177, 1906.

Heterosciurus styani Matschie, Wiss. Ergebn. d. Exped. Filchner nach China u. Tibet 1903-05, vol. 10, pt. 1, p. 211, 1908.

Callosciurus erythræus styani Robinson and Kloss, Records Indian Mus., vol. 15, p. 200, 1918.

Sciurus caniceps canigenus A. B. Howell, Journ. Washington Acad. Sci., vol. 17, p. 81, 1927.

Callosciurus erythræus woodi Harris, Occ. Papers Mus. Zool., Univ. Mich., no. 228, p. 1, 1931.

Type specimen.—An adult female, skin and skull, No. 86.10.28.5, British Museum, from between Shanghai and Hangchow, probably Kahing where others were taken.

Description.—This is merely a pale-bellied race of the usual red-bellied type of this species. Dorsally it is quite like the race *C. e. ningpoensis* in its uniform tawny-olive coloration, produced by a very even mixture of minute black and ochraceous rings on the tips of the hairs. The sides of the head and the upper surfaces of the hands and feet are a nearly uniform dull gray, mixed with blackish. The sides are slightly but not noticeably lighter in their pale ochraceous tint than the back. Throat and lower side of the forearms and the ankles dull gray. Tail above like the back in its warm russet and black mixture, the terminal hairs with long black bases and tips of ochraceous; beneath, the tail is paler, with a grayish central area. The entire under surface of the body, upper arms and the hind legs nearly to the ankle varies from a nearly

uniform cream buff to pale ochraceous buff, in striking contrast to the brilliant chestnut, with gray sides, of *C. e. ningpoensis*.

The skull is indistinguishable from that of the latter.

Measurements.:—The following measurements are from fresh specimens by the collector:

No.	Head and body	Tail	Hind foot	Ear	Locality
241509 USNM	194	155	47	21.0	Chekiang
241508 USNM	195	146	47	19.0	Chekiang
241510 USNM	209	160	51	21.5	Chekiang
241511 USNM	202	155	49	20.0	Chekiang
241512 USNM	190	147	48	22.0	Chekiang

CRANIAL MEASUREMENTS OF *CALLOSCIURUS ERYTHRÆUS STYANI*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
241508 USNM	48.4	41.5	23.8	29.0	22.7	12.0	9.8	9.4	Chekiang
241509 USNM	49.5	42.0	24.6	30.0	22.6	12.1	9.7	9.8	Chekiang
241510 USNM	48.8	42.6	24.5	28.0	23.1	11.6	9.3	9.1	Chekiang
241511 USNM	50.0	43.6	25.7	30.4	23.0	12.4	9.7	9.8	Chekiang
241512 USNM	48.8	41.8	23.8	30.3	23.5	11.8	9.9	—	Chekiang
27889 MCZ	50.3	44.8	25.6	31.8	22.5	12.3	9.6	9.3	Anhwei
27890 MCZ	49.9	43.0	24.8	31.0	23.3	12.1	9.5	9.2	Anhwei
8.8.11.30 BM	51.3	—	25.6	31.1	23.4	12.6	9.5	9.4	Chekiang
93.6.8.7 BM	50.0	43.5	25.8	30.8	24.3	12.9	9.3	9.3	Chekiang
55827 U. MICH. (type of <i>C. e. woodi</i>)	48.4	42.5	24.9	30.7	24.0	12.1	9.9	9.6	Kiangsu
56531 U. MICH.	49.4	43.3	25.2	29.6	23.0	11.6	9.5	9.0	Anhwei

Nomenclature.:—Various names have been applied to the pale-bellied race of squirrel that is found in the lowlands and plains country from the Shanghai region inland to Anhwei and the middle Yangtze basin. Both Swinhoe (1870c) and Milne-Edwards used the specific name *griseipectus* or *griseopectus* (the latter the original spelling). This was a name given by Blyth (Journ. Asiatic Soc. Bengal, vol. 16, p. 873, 1847) to a squirrel in the collection of the Indian Museum, without locality, presented by Raja Mullick. It was regarded by Bonhote (1901) as identical with *C. e. gordonii*, which it would thus antedate, but Robinson and Kloss (1918), who have examined the type specimen, do not agree with this conclusion, but instead apply the name to specimens from Amoy and Foochow, although admitting that the latter are more richly colored. If their decision is accepted, the name would then supplant *C. e. ningpoensis* for a squirrel of this group. Since it does not seem possible to arrive at a certain conclusion in the matter, it may be best to regard the name as indeterminate, and since the type was presented to the Asiatic Society by Raja Mullick,

the presumption is equally likely that it came from somewhere in India. Swinhoe's *Sciurus chinensis* is apparently the same as the race *C. e. styani*, and Milne-Edwards had the same squirrel in mind when he recorded it under the former name as a variety found near Shanghai. Bonhote (1901, p. 165), however, as previously mentioned, wrote that the skull of Gray's type of *Macroxus chinensis* had since been removed from the skin and found to be allied to "*Sciurus*" (now *Tomeutes*) *lokriah* and hence probably came from India, where Reeves, who presented the specimen, also traveled. According to Matschie (1908), who examined the type skin of Hilzheimer's *Herpestes leucurus*, this, too, is the same as *C. e. styani*, so that *Herpestes albifer*, a substitute for the preoccupied *H. leucurus*, is likewise a synonym. Robinson and Kloss (1918), in their list of Asiatic squirrels, rightly regarded *styani* as a race of the wide-ranging *Callosciurus erythræus*. Finally, A. B. Howell in 1927 described typical examples of the same race as *Sciurus caniceps canigenus*, but *Callosciurus caniceps* is a Malayan species, larger than *C. erythræus*, and on comparison of a large series of the eastern Chinese races with the type of *S. c. canigenus*, it now becomes clear that it, too, is *C. e. styani*. Apparently, also, the race *C. e. woodi*, lately described from near Nanking, is really the same thing, the type specimen having the lower side slightly paler than the average.

Occurrence and Habits.—The pale-bellied race of *Callosciurus erythræus* is first found in the lowlands and plains near Shanghai, and inland takes the place of the red-bellied race of the coast, *C. e. ningpoensis*. At Tunghu, Chekiang, I previously recorded two specimens among other red-bellied individuals from that locality. There is nothing to show that they were found in a different type of country, but they do indicate that this variation sometimes occurs along with the red-bellied type in this region. Milne-Edwards mentions specimens in the Paris Museum from near Shanghai, and Swinhoe (1870c) records two in the British Museum of a dusky white below, brought from the same locality. He adds that on his journey from Ningpo to Shanghai, overland, he saw many of this species in groves of trees. Père David also collected specimens of this gray-bellied squirrel in Chekiang. Milne-Edwards mentions that their bellies are occasionally washed with brownish or red, and notes that several living in the menagerie of the Paris Museum showed seasonal variation in the amount of color below. This cannot be great, however, for I have examined series of winter skins from Chekiang in which the two types of coloring were present. Styan, for whom the race is named, gives its range as the Yangtze valley from Kiukiang, Kiangsi, down to the flat country of the delta between Shanghai and Hangchow, mostly confined to the plains, but occasionally found in the low foothills. Cabrera (1922) applies the name to a specimen with pinkish-buff belly from Foochow, Fukien, but this is perhaps best regarded as a variation of the race *C. e. ningpoensis*, since the red-bellied type pre-

dominates there. Nevertheless, he may be correct in saying that it is the squirrel of the plains and valleys, while *C. e. "castaneoventris,"* that is, *C. e. ningpoensis*, is the mountain form.

Jacobi (1922, p. 12) has also reported it from the mountains east and west of the Min valley in Fukien, but his description shows that he actually had the red-bellied race in hand. In the original description of *Sciurus styani*, Thomas mentions skins from Linshan hills, Kiukiang, collected by Styan. Matschie (1908) records it on the basis of six skins obtained from Hinganfu in south-eastern Shensi, but these seem to have been trade skins, and probably were not of local origin. The series that served as the basis of Howell's *S. caniceps canigenus* was obtained in northeastern Chekiang at Kangpu and Haiyenhsien. Finally, the race *C. e. styani* extends into Anhwei, whence the University of Michigan has a series from the Wan Mountains, one hundred miles southwest of Nanking.

Specimens examined:—In all, thirty, namely:

Anhwei: Wan Mountains, one hundred miles southwest of Nanking, 6 (Univ. Mich.); Tekan, 1 (Univ. Mich.); Chiensan, 2 (B. M.); Chinteh, 1 (B. M.); Hinchowfu, 1 (B. M.).

Kiangsu: Lungtan, 2, including type of *C. e. woodi* (Univ. Mich.).

Chekiang: Kangpu, near Hangchow, 2, including type of *Sciurus caniceps canigenus* in the U. S. National Museum; Haiyenhsien, 3 (U. S. N. M.); Tunglu, 2; Kahing, southwest of Shanghai, 5 (B. M.); Haiyee, Hangchow Bay, 4, including type (B. M.); Yangtze valley, Pantze, 1 (B. M.).

264. ***Callosciurus erythræus bonhotei*** (Robinson and Wroughton)

Sciurus castaneoventris bonhotei Robinson and Wroughton, Journ. Federated Malay States Mus., vol. 4, p. 234, 1911.

Sciurus castaneoventris bonhotei Thomas, Proc. Zool. Soc. London, 1912, p. 134.

Callosciurus erythræus bonhotei Robinson and Kloss, Records Indian Mus., vol. 15, p. 200, 1918.

Type specimen:—A skin and skull, No. 8.8.11.25, British Museum, from Chinchiansan, Szechwan, China. Collected by F. W. Styan.

Description:—This is a slightly larger race than *C. e. castaneoventris* and *C. e. ningpoensis* to the eastward, and in winter pelage is longer-haired and more richly colored. The entire upper surface of the body, head and ears is a minutely ticked olive and black, with a distinct yellowish tint, brighter than in the other races mentioned which are more grayish. The sides hardly differ from the back, and the tail is similar except that the hairs are much longer and at the terminal third show black cross-banding with ochraceous tips. The black subterminal patch on the tail, so noticeable in the other races mentioned, is lacking in the specimen examined. The backs of the hands and feet are nearly black, with a slight ticking of greenish yellow. Throat and cheeks like the top of the head. Under side of the body from the lower throat to anus and on the

inner sides of the limbs to just proximal of the wrist and ankle, bright chestnut red. The only specimen examined shows no tendency of the gray mixed area of the throat to extend backward as a median line.

The skull is broader with the teeth slightly larger than in the average Chekiang squirrel, but is indistinguishable from Hainan skulls.

Measurements.—Although Robinson and Wroughton believed this to be a rather large race, their measurements were taken on the skin instead of from fresh specimens. Nevertheless, it is doubtless bigger than the squirrels of the coastal region to the east.

The describers give as measurements of the skull: total length, 52 mm.; zygomatic width, 34; upper cheek teeth, 11. A skull from Wanhhsien, eastern Szechwan, measures: palatal length, 25 mm.; zygomatic width, 32.5; width across molars, 12.6; upper cheek teeth, 12.7.

Occurrence and Habits.—This is the race of Red-bellied Squirrel of eastern Szechwan, a brightly colored, black-toed animal, lacking the gray tones of the coastal race, *C. e. ningpoensis*, and the white tail-tip of typical *C. e. castaneiventris*, but having the belly a deep chestnut as in the latter and so quite different from the nearly gray belly of *C. e. styani*, its nearest neighbor down the Yangtze. No doubt it intergrades in Hupeh and Kweichow with the adjacent subspecies, but specimens are not available for the more precise determination of the limits of its range. Thomas (1912e, p. 134) has recorded specimens from Yuenchinghsien (southwest of Yachow) and Ningyuanfu (south of Fulin) in eastern Szechwan, both collected by M. P. Anderson. Dolan collected three at Yachow. Osgood (1932) records a specimen secured by the Kelley-Roosevelts Expedition at Omei Shan. It is a forest-loving squirrel and apparently rare throughout the region of the Yangtze basin where most of the known specimens have been taken, for Zappey did not obtain it when he visited the Wa Shan and neighboring country in 1907, and the American Museum Asiatic Expeditions did not meet with it. Jacobi (1922, p. 12), however, records as *Sciurus castaneiventris* what must be specimens of this race from the mountains near Wanhhsien, Yachow, Omei and Wa Shan, in eastern Szechwan, and others as *bonhotei* from Seurong.

Specimens examined.—Six, namely:

Szechwan: Wanhhsien, 1; Chinchiansan, 1, the type (B.M.); Yachow, 3 (A.N.S.P.); Yuenchinghsien, 1 (B.M.).

265. *Callosciurus erythraeus gordonii* (Anderson)

GORDON'S RED-BELLIED SQUIRREL

Sciurus gordonii Anderson, Proc. Zool. Soc. London, 1871, p. 140; Anat. and Zool. Researches Western Yunnan, p. 240, pl. 19 (col.), 1879.

Sciurus castaneiventris gordonii Bonhote, Ann. Mag. Nat. Hist., ser. 7, vol. 7, p. 164, 1901.

Callosciurus erythraeus gordonii Robinson and Kloss, Records Indian Mus., vol. 15, p. 198, 1918.

Type specimens.—The cotypes of this race are Nos. 9257, 9268, skins and skulls, in the Indian Museum, Calcutta, from Bhamo, Upper Burma, collected in September and February, 1868, respectively, by Dr. John Anderson (see Robinson and Kloss, 1918, p. 198).

Description.—This is a race slightly darker than *C. e. michianus*, corresponding with its more lowland habitat in extreme southwestern Yunnan and Burma. The upper parts of the head, body, and limbs are a similar minutely ticked olivaceous, due to the very narrow bands of ochraceous and black alternating on the individual hairs. In *C. e. gordonii* the pale bands are a deeper tint of ochraceous instead of pale buff as in *C. e. michianus*, so that the entire dorsal area is darker, more olive in tone than in the paler, grayer-sided Likiang form. There is also less of a marked mid-dorsal concentration of black hairs, resulting in a very even mixture of the color elements. Both fore and hind feet are much darker, black with a few minute scattered ochraceous hairs. The ears are either colored like the back or may show a slight tendency to the development of orange hairs on the upper edge, thus approaching the more orange ears of *C. e. michianus*. The lower surface is bright ferruginous from the proximal part of the forearm nearly to the ankles, with a median line of dark olivaceous minutely peppered with ochraceous buff. This dark median line may extend nearly or quite to the base of the tail. The latter is practically like the back above and below, with the long tips of the terminal hairs ochraceous, and on the under side a black patch, more or less developed, below the tip. This race grades into *C. e. michianus* by insensible degrees but is usually to be distinguished by its darker shades, the dark median stripe on the lower side, and the blacker feet.

Measurements.—In size this race does not seem to differ from others of southern China. The following dimensions were taken in the field by the collector:

No.	Head and body	Tail	Hind foot	Ear	Locality
43210	220	188	52	21	Yunnan
43211	200	182	52	23	Yunnan
43212	200	170	45	20	Yunnan
43216	220	175+	54	22	Yunnan
43221	215	155	51	—	Yunnan
43245	200	185	52	22	Yunnan

CRANIAL MEASUREMENTS OF *CALLOSCIURUS ERYTHRÆUS GORDONI*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
43213	49.0	41.8	24.0	29.0	22.5	12.2	9.6	9.6	Yunnan
43211	51.2	45.0	25.3	30.5	23.9	12.5	10.0	9.7	Yunnan

Occurrence and Habits.—In the lower hill country of extreme southwestern Yunnan, the Red-bellied Squirrels are much darker, more olivaceous in tint than elsewhere in Yunnan, usually with blackish feet and a gray-mixed median line on the belly of much the same tint as the color of the back. These represent the race *C. e. gordonii* described from Bhamo, across the border in Burma. Specimens from the Homushu Pass and Taipingpu, Yunnan, seem uniform in these characters. Others from Mucheng, Salween drainage, have the grizzled mid-ventral line more or less mixed with ochraceous, and in occasional specimens it may be absent, or it may extend but a very short distance on the chest, and so is intermediate between *C. e. gordonii* and *C. e. michianus* in this respect. Skins from the Salween drainage are of this intermediate type. A series from the Namting River at the Burma border seems to be varying toward the Siamese race *C. e. pranis*, and has the mid-ventral stripe either altogether absent, or so invaded by ochraceous that the stripe is less clearly defined and of an ochraceous tint, or the whole belly may be much more of the latter tone than the deep chestnut of *C. e. gordonii*. Probably all that can be safely said of the squirrels from this area is that they are intermediate in character.

As in the case of *C. e. ningpoensis*, the number of young seems to be small, for a female killed March 1 on the Namting River contained two embryos only.

Specimens examined.—In all, thirty-eight, as follows:

Yunnan: Changlung, Salween River, 8; Chenkang, Salween drainage, 2; Hsiaomengtung, 1; Homushu Pass, 3; Mucheng, Salween drainage, 7,000 feet, 7; Huiyao, 1; Taipingpu, Shweli River, 4; Watien, 2; Taishuitang, 1; intermediates, Namting River, Burma border, 9.

266. *Callosciurus erythræus michianus* (Robinson and Wroughton)

LIKIANG SQUIRREL

Sciurus castaneiventris michianus Robinson and Wroughton, Journ. Federated Malay States Mus., vol. 4, p. 235, 1911.

Sciurus castaneiventris hamobaphes G. M. Allen, Proc. Biol. Soc. Washington, vol. 25, p. 177, 1912.

Callosciurus erythræus michianus Robinson and Kloss, Records Indian Mus., vol. 15, p. 200, 1918.

Type specimen.—A skin and skull, No. 8.11.14.13, British Museum, from Meechee in the Likiang highlands, Yunnan, China. Collected by F. W. Styan.

Description.—This race is rather variable in color, and is more or less intermediate in its characters between the race *C. e. gordonii* of southwestern Yunnan and Burma, and the race *C. e. gloveri* of the Szechwan highlands. The general color of the upper surface of head, body and limbs is an olive gray, almost as pale as in the latter, the effect being due to a minute ticking of black and pale-buffy bands on the hairs. The upper part of the ears, on their exposed portion, is orange, but not so brilliantly so as in *C. e. gloveri*. The tail is like the back

at its base, but the rest of the upper side has the hairs banded and tipped with ochraceous buff. The lower side is similar but slightly paler, and there is usually a tendency for the black bands to form a black spot just below the tip. The dark chestnut red of the belly varies considerably in tint and extent. It may begin at the upper throat and extend quite to the anus, and on the inner sides of the limbs almost to the wrist or ankle, but in most skins the grayish of the throat is extended back as a median stripe which may be very narrow and chiefly yellow or gray and yellow mixed, or it may be a centimeter or two wide and consist of minute gray-and-black-ticked hairs. In about half of a series of some forty skins there was no complete stripe, but it is usually indicated by the continuation of the gray of the throat back in a narrowing line to the chest, so that much of the upper throat is gray, while in *C. e. gloveri* it is red throughout.

The skull is not distinguishable from that of the neighboring races.

Measurements.—In size this race does not show noteworthy differences from the other races. The following measurements, however, may be regarded as those of topotypes, and were taken in the field by the collector.

No.	Head and body	Tail	Hind foot	Ear	Locality
43191	195	170	53	25	Yunnan
43192	200	178	53	22	Yunnan
43193	205	—	51	23	Yunnan
43194	200	176	55	22	Yunnan
43195	210	200	55	24	Yunnan
43196	200	190	56	25	Yunnan
43197	200	193	54	24	Yunnan

CRANIAL MEASUREMENTS OF *CALLOSCIURUS ERYTHRÆUS MICHIANUS*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
84900	48.5	40.8	23.4	29.0	23.8	12.0	10.3	10.5	Yunnan
84901	51.5	44.0	25.0	30.3	23.0	12.3	9.7	9.4	Yunnan
84902	53.0	45.0	25.3	31.8	24.5	13.2	11.0	10.2	Yunnan
84904	48.7	40.9	23.4	29.0	23.5	12.1	9.8	9.6	Yunnan
84906	51.0	43.6	24.5	28.8	23.5	12.0	10.0	9.6	Yunnan
84907	50.5	42.2	23.6	29.6	24.0	12.3	10.3	10.0	Yunnan
84913	51.0	43.8	23.8	30.7	24.2	12.4	10.2	10.0	Yunnan
84915	49.6	41.8	22.8	29.6	23.0	12.0	10.0	9.7	Yunnan
84908	51.5	43.6	24.1	30.0	24.0	12.8	9.2	9.3	Yunnan
13693 MCZ	48.7	41.0	23.0	29.1	23.1	12.0	9.5	9.3	Yunnan

Occurrence and Habits.—The squirrel of the Likiang Range and south-eastern Yunnan is not so dark as *C. e. gordonii*, but not so pale as *C. e. gloveri* to the north. It has the mid-ventral line developed in about half of the

specimens as a gray band nearly like the back in its color elements, but in others the band is yellow, or bordered with yellow, with less of the black-ringed hairs. In others, again, the red begins abruptly on the lower throat and extends uninterruptedly to the base of the tail. All gradations may be found. After further comparison of the original series of red-bellied squirrels from Chihping, southeastern Yunnan, that I described as *S. c. hæmobaphes* in 1912, I find that, although none of the five specimens has a mid-ventral stripe, yet, as this same condition obtains in some of the Likiang specimens, it does not seem reasonable to regard it as a valid race, for they are in other respects identical. Probably, then, *C. e. michianus* is the race that is found all over the central and eastern part of Yunnan, merging into *C. e. gordonii* or perhaps into *C. e. pranis* in the extreme southwest, and into the quite different *C. e. hendeei* in northern Tongking.

Specimens examined:—In all, forty-two, as follows:

Yunnan: Chihping, 5 (M. C. Z., including type of *hæmobaphes*); Fumin, 1; Hangai, forty miles east of Talifu, 1; Kaochow, south end of Lake Tali, 6; Kunyang, 1; Likiang, 9; Makaihsien, 7; Malipa, 1; Talifu, 3; Wutinghsien, 1; Yunnanfu, 5; Yunnanyi, 2.

267. *Callosciurus erythræus gloveri* Thomas

Callosciurus erythræus gloveri Thomas, Journ. Bombay Nat. Hist. Soc., vol. 27, p. 502, 1921.

Sciurus castaneiventris bonholei G. M. Allen, Mem. Mus. Comp. Zool., vol. 40, p. 233, 1912 (not of Robinson and Wroughton).

Type specimen:—A skin and skull, No. 13.9.13.3, British Museum, from Nagchuka, western Szechwan, at 10,000 feet altitude. W. R. Zappey, collector.

Description:—This race, as Osgood (1932) has already pointed out, is closely allied to *C. e. michianus* of the Yunnan highlands, but differs in its more ochraceous ears and the lack of a mid-ventral gray stripe. Like that race, the entire back from muzzle to base of tail, and the fore limbs are a finely ticked gray and black with a slightly buffy tinge. The center of the back is darkened by a greater admixture of black hairs over this region. The ears, except the hidden posterior side, are bright ochraceous-rufous, strongly contrasting with the mixed gray, buffy, and black of the rest of the head. The tail shows a tendency to the formation of alternating black bars, and the long tips of the hairs of the terminal half are ochraceous buff. The chin and upper throat are practically like the back, while the entire under side of body and limbs, *including the wrists and ankles* and a slight fringe along the side of the foot, is bright orange rufous.

The skull is not distinguishable from that of the small coast race, *C. e. ningpoensis*.

Measurements.—The following measurements were made in the field by the collector of the type and topotypes, W. R. Zappey:

No.	Total length	Tail	Hind foot	Ear	Locality
7826 MCZ	405	200	55	—	Szechwan
7828 MCZ	405	185	55	—	Szechwan
7830 MCZ	417	185	53	—	Szechwan
7831 MCZ	412	181	53	—	Szechwan
7832 MCZ	390	184	53	—	Szechwan

CRANIAL MEASUREMENTS OF *CALLOSCIURUS ERYTHREUS GLOVERI*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
7826 MCZ	49.5	42.7	23.0	30.5	24.1	12.8	9.9	9.7	Szechwan
7827 MCZ	45.5	39.2	22.0	26.9	21.8	12.5	9.5	9.5	Szechwan
7828 MCZ	50.8	43.8	24.7	30.4	23.1	12.7	9.9	9.5	Szechwan
7830 MCZ	49.8	42.6	24.0	31.8	23.4	13.6	9.6	9.7	Szechwan
7832 MCZ	50.0	41.7	23.3	30.6	22.4	12.5	9.6	9.8	Szechwan
13.9-13.3 BM	50.3	42.8	23.7	30.5	23.7	12.7	9.9	9.8	Szechwan

Occurrence and Habits.—This is a very handsome squirrel with bright rufous ears that contrast sharply with the color of the rest of the head and body. The lower side is uniformly bright ochraceous-rufous without any indication of a median gray line such as is normally present in the race of the Likiang region, *C. e. michianus*, while the wrists and ankles are also red. It is a squirrel of high altitudes, for the type specimen from Nagchuka was from an altitude of 10,000-11,000 feet, and others from the Ramala Pass, not far to the west, were from altitudes of 12,000-13,000 feet. It apparently inhabits the alpine forests of western Szechwan and doubtless extends southward along the highlands to northern Yunnan, for Osgood (1932) records two from Yungning in that province, as well as others from Baurong and Muli in Szechwan.

Specimens examined.—Including the type, fourteen, namely:

Szechwan: Nagchuka, 5; Ramala Pass, 3; Baurong, 1 (A.N.S.P.); Toloko, south of Muli, 2 (A.N.S.P.); Hokow (ten to forty miles from Nagchuka), 2 (A.N.S.P.); ?locality, 1 (A.N.S.P.)

268. *Callosciurus quinquestriatus quinquestriatus* (Anderson)

Sciurus quinquestriatus Anderson, Proc. Zool. Soc. London, 1871, p. 142, pl. 10; Anat. and Zool. Researches Western Yunnan, p. 266, 1879.

Tomeutes quinquestriatus Robinson and Kloss, Records Indian Mus., vol. 15, p. 225, 1918.

Callosciurus quinquestriatus Thomas, Ann. Mag. Nat. Hist., ser. 9, vol. 17, p. 640, 1926.

Type specimen.—A skin and skull, No. 9463, Indian Museum, Calcutta, from Ponsee, Kakhyen Hills, 3,200 feet, Yunnan-Burma border. Collected February 24, 1868, by Dr. John Anderson. In his later work (1879) Anderson

writes: "I obtained this species in April, in the Kakhyen Hills, within the Chinese border."

Description.—"Grizzled above, olive brownish-grey, with a distinct rufous tint, deepest on the dorsal surface; annulation fine, as in the grizzled squirrels generally; chin and throat obscurely grizzled greyish, washed with reddish; a rufous grizzled blackish-brown band from the chest along the middle line of the belly to the vent; external to this, on either side, a broad pure white well-defined band from the side of the chest along the belly and prolonged along the inguinal region to the vent; a broad black band from the hollow of the axilla along the side of the belly, expanding on the inside of the thighs, where it is faintly washed with greyish; toes black, with rufous annulations. Tail nearly as long as the body and head, concolorous with the body, but the black and rufous annulations much broader and more marked, assuming the form of indistinct rufous and black rings on the posterior third; tip of tail jet black, narrowly terminated with greyish" (Anderson, 1879, p. 266).

Measurements.—Anderson states that the head and body measure 9.50 inches (240 mm.); the tail, 7.10 inches (181 mm.).

The skulls of four specimens from the Yunnan border measure as follows:

CRANIAL MEASUREMENTS OF *CALLOSCIURUS QUINQUESTRIATUS*

No.	Greatest length	Basal length	Palatal length	Zygomastic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
88.12.1.62 BM	51.6	44.5	25.6	30.3	24.0	12.4	9.7	9.7	Burma
88.12.1.63 BM	51.3	44.7	24.6	30.1	23.3	12.2	10.2	9.8	Burma
8.6.20.3 BM	(49.0)	43.8	25.4	29.5	22.3	12.2	9.6	9.5	Burma
8.6.20.4 BM	52.0	45.7	26.4	32.3	24.5	13.1	9.5	9.5	Burma

Nomenclature.—There appears to be some uncertainty as to the generic position of this species. By Anderson it was described as a member of the genus *Sciurus* as then understood, but Robinson and Kloss (1918, p. 225), in their list of oriental squirrels, place it without further explanation in the genus *Tomeutes*, founded by Thomas in 1915 for the eastern species with the more specialized type of compound baculum in which "the lamina is attached to the side of the end of the shaft, and is developed into a long triangular and pointed blade, recurved backwards towards the hilt of the shaft, which it may equal or exceed in length." The present species was not listed either definitely or tentatively in either of the genera *Callosciurus* or *Tomeutes* by Thomas (1915a) in his account, but in describing the new race *C. q. sylvester* in 1926, he retains it in the former, so that, pending more definite information, I have followed this course.

Occurrence and Habits.—According to Thomas's (1926) review of this

group, the typical race is found in a very limited area on the extreme southwestern border of Yunnan and the adjacent part of Burma. Seven specimens from Bhamo vary in the intensity and breadth of the white stripes on the under side. These run "forward to the hinder neck and on to the under surface of the forearms, and posteriorly to the inguinal region and on to the inner end of the hind legs, sometimes reaching the ankles. The median dark line begins on the middle of the chest and ends before the inguinal region, while the lateral black stripes are restricted to the area behind the axillae and in front of the hips." Slightly to the east in western Yunnan still, the same author detects a slight color difference which is the basis of the following race, *C. q. sylvester*. These seem to be rare and local squirrels of which very little is known.

I have examined the series of these squirrels in the British Museum and agree with Thomas that those from about Bhamo are apparently slightly different, with more prominent black side stripes than the single one available of the race *C. q. sylvester*.

Specimens examined:—Four, from about Bhamo, northeastern Burma (B.M.).

269. *Callosciurus quinquestriatus sylvester* Thomas

Callosciurus quinquestriatus sylvester Thomas, Ann. Mag. Nat. Hist., ser. 9, vol. 17, p. 641, 1926.

Type specimen:—An adult male, skin and skull, No. 25.10.5.31, British Museum, from the Shweli-Salween divide, altitude 9,000 feet, western Yunnan. Collected September, 1925, by George Forrest.

Description:—General color "above olivaceous of a less warm tone than in true *quinquestriatus*. Light area below suffused with buffy anteriorly, quite white on belly, its extension forwards about as" in that race. "Dark stripes much suppressed, the median one grey-mixed, narrow, commencing on the chest and ending on the belly short of the inguinal region; the lateral ones absent or just faintly perceptible. Inguinal region and inner side of hind legs broadly washed with cinnamon. Ears coloured like head, scarcely more buffy. Hands and feet darkened terminally" (Thomas, 1926).

Measurements:—The dimensions of the type, measured on the skin, are, according to Thomas: head and body, 225 mm.; hind foot, 48.

Occurrence and Habits:—This race is based on the single specimen from the Shweli-Salween divide in western Yunnan, at no great distance east of the localities on the Burma-Yunnan border whence comes the typical form. The indistinctness of its belly stripes, however, as compared with several specimens from the vicinity of Bhamo, probably indicates, as Thomas believed, a local variation perhaps comparable with the paler race, *michianus*, of *Callosciurus*

erythræus found over much of Yunnan, while on the Burma border, as about Tengyueh and the Kakhyen Hills, the more saturate race, *gordonii*, takes its place.

Nothing is recorded of its habits or further distribution.

Specimens examined:—One, the type (B. M.).

Genus *Dremomys* Heude

LONG-NOSED SQUIRRELS

Dremomys Heude, Mém. concern. l'Hist. Nat. de l'Emp. Chin., vol. 4, pt. 2, p. 54, 1898.

Sciurus Milne-Edwards, Rev. et Mag. de Zool., ser. 2, vol. 19, p. 230, 1867 (in part).

Funambulus J. A. Allen, Bull. Amer. Mus. Nat. Hist., vol. 22, p. 472, 1906.

Zetis Thomas, Journ. Bombay Nat. Hist. Soc., vol. 18, p. 245, 1908; Ann. Mag. Nat. Hist., ser. 8, vol. 2, p. 136, 1908 (type, *Sciurus rufigenis*).

Squirrels of this genus, although agreeing with typical *Sciurus* and with *Callosciurus* in the number of their teeth, present enough points of difference to constitute them a very distinct group. In external characters, their coloration, with a tendency to develop small areas of bright color contrasting with the generally olivaceous color of the back, is very striking. Thus there may be a rufous spot on the thighs, on the cheeks, or on the lower surface of the tail, but no very extensive area of such decoration. The ears are not tufted, nor are there any other noteworthy developments of the usual sciurine appearance. The soles of the hind feet are naked nearly to the heel, and have two elongate metatarsal pads in addition to four beneath the bases of the proximal phalanges. There are three pairs of mammae, one pectoral, two inguinal. The skull is remarkable in many particulars. Most noticeable is the very long rostrum which, instead of being short and broad, with the length of nasals less than the interorbital distance, as in the two genera mentioned, is slender and tapering, with the length of the nasals much exceeding the interorbital space. The nasals overhang the incisors considerably instead of ending nearly at their level. The dorsal profile is much flatter, without the upward bulge at the back of the postorbital processes, and these latter are themselves weakly developed and short. The tooth formula, $i. \frac{1}{1} c. \frac{0}{0} pm. \frac{2}{1} m. \frac{3}{3} = 22$, is the same in all three but in *Dremomys* the cusps of the molariform teeth are higher, so that in the upper series the three cusps of the two anterior large teeth, which are nearly subequal in *Sciurus*, show in *Dremomys* a very low anterior cusp and two much higher posterior ones. Thomas (1915a) has pointed out that the characters of the baculum or penis bone are very different from those of the former genus and indicate affinities with *Callosciurus* and *Tomeutes*. In *Dremomys* the baculum is compound but of the "more specialized" type as compared with that of *Sciurus*; that is, there is a shaft with a lamina attached by cartilage "to the side of the end of the shaft," and this lamina "is developed into a long triangular

and pointed blade, recurved backwards towards the hilt of the shaft, which it may equal or exceed in length," instead of being a narrow blade lying in the concavity of the curvature of the shaft as in the simpler compound type represented by *Callosciurus*.

In proposing the generic name *Dremomys*, Père Heude included in it *Dremomys* (formerly *Sciurus*) *pernyi* and three supposed new species, all of which are members of what is now regarded as *Sciurotamias*, without designating any one of them as the type. Nor did Thomas, in resuscitating the name in 1908, mention any type, although he regards the name as equivalent to his later-proposed *Zetis*. In view of this fact and that *Sciurus pernyi* Milne-Edwards is implied as the most extreme exponent of the characters intended to be brought out, I would formally select this as the genotype.

The squirrels of this group are arboreal in contrast to the rock-living genus, *Sciurotamias*. There appear to be two species represented in China, with a number of local races of each, some so well marked that they are even accorded specific rank by many authors. The group occurs over the southern half of China and in Formosa, extending from lower levels to high altitudes in the western highlands of Szechwan, but in a general way not ranging northward of the latitudes of the Yangtze basin, beyond which it is replaced by the genus *Sciurotamias*.



FIG. 25. Distribution Map.

Dremomys

1. *D. pernyi pernyi*
2. *D. pernyi modestus*

3. *D. pernyi senex*
4. *D. pernyi calidior*

5. *D. pernyi flavior*
6. *D. pernyi howelli*

The following key includes the Chinese forms only.

KEY TO THE CHINESE SQUIRRELS OF THE GENUS *Dremomys*

- | | |
|---|---------------------------------|
| A. Tail rusty red only at the base on the under side, elsewhere grayish buff..... | <i>Dremomys pernyi</i> |
| a. Back uniform mixed black and ochraceous, giving an olivaceous tint. | |
| a'. Ear patches conspicuous, buffy or white. | |
| a''. Lower surface washed with ochraceous..... | <i>D. pernyi pernyi</i> |
| b''. Lower surface nearly white, or faintly washed with buffy. | |
| 1. Under side of forearms gray..... | <i>D. pernyi senex</i> |
| 2. Under side of forearms white..... | <i>D. pernyi flavior</i> |
| b'. Ear patches inconspicuous..... | <i>D. pernyi modestus</i> |
| b. Back not uniform olivaceous, but brownish or with the fore part distinctly darkened. | |
| a. Back brownish tinted..... | <i>D. pernyi calidior</i> |
| b. Back distinctly darker anteriorly..... | <i>D. pernyi howelli</i> |
| B. Tail rusty red in the center throughout the entire under side.. | <i>Dremomys rufigenis</i> |
| a. A conspicuous rusty mark on the hip. | |
| a'. Cheeks and sides of neck not conspicuously reddish. . . | <i>D. rufigenis pyrrhomerus</i> |
| b'. Cheeks and sides of neck rusty. | |
| a''. Top of head and outer side of fore limbs reddish.. | <i>D. rufigenis riudonensis</i> |
| b''. Top of head and outer side of fore limbs not reddish | <i>D. rufigenis melli</i> |
| b. No conspicuous rusty mark on hip..... | <i>D. rufigenis ornatus</i> |

270. *Dremomys pernyi pernyi* (Milne-Edwards)

PERNY'S LONG-NOSED SQUIRREL

- Sciurus pernyi* Milne-Edwards, Rev. et Mag. de Zool., ser. 2, vol. 19, p. 230, pl. 19, 1867.
Dremomys pernyi Heude, Mém. concern. l'Hist. Nat. de l'Emp. Chin., vol. 4, pt. 2, p. 55, 1898.
Dremomys pernyi pernyi Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 17, p. 392, 1916.
Dremomys pernyi griselda Thomas, loc. cit.
Dremomys rufigenis lentus A. B. Howell, Journ. Washington Acad. Sci., vol. 17, p. 80, 1927.

Type specimen.—A skin and skull in the Muséum d'Histoire Naturelle at Paris obtained from an unknown locality in Szechwan, China, by Monseignor Perny.

Description.—The various races of this squirrel that have been described differ very little among themselves, so that it becomes partly a matter of personal preference how far it is worth while to subdivide the species. The typical race is thus described by Thomas (1916a) from specimens from north-western Yunnan: "Size comparatively large, an adult skull measuring 53.5 mm. in greatest length, with a facial length of 27.6. General colour saturate, rich brownish olivaceous, the [buffy] postauricular patches strongly contrasted. Middle area of underside of tail grizzled buffy or brown, varying a good deal, as it does in all the races, but never clear grey. The buffy colour is clearly

shown in Milne-Edwards's original plate." The base of the tail on the under side is orange rufous for about a fifth of the length. Outer sides of the thighs yellowish buff, as is also the entire under side of the throat and belly.

The skull as already noted is peculiar in this species for the length and taper of the rostrum, combined with the full, deep brain case.

Measurements.—Collectors' measurements are:

MEASUREMENTS OF <i>DREMOMYS PERNYI PERNYI</i>					
No.	Head and body	Tail	Hind foot	Ear	Locality
22.9.1.63 BM	197	152	48	24	Yunnan
22.9.1.64 BM	202	147	46	23	Yunnan
22.9.1.65 BM	200	170	46	22	Yunnan
22.9.1.66 BM	191	144	45	23	Yunnan
26.5.11.19 BM	220	180	44	—	Yunnan

A skull in the Museum of Comparative Zoölogy measures: greatest length, 49.3 mm.; basal length, 41.6; palatal length, 23.6; zygomatic width, 26.1; mastoid width, 20.2; width across molars, 11; upper cheek teeth, 8; lower cheek teeth, 8.2.

Nomenclature.—After examining the series in the British Museum on which Thomas based the race *D. p. griselda*, I find myself quite unable to detect any considerable differences, and am therefore placing it in the synonymy. There seems to be no doubt that A. B. Howell's *Dremomys rufigenis lentus* based on a specimen from Wenchwanhsien, Szechwan, is likewise the same.

Occurrence and Habits.—No exact locality was mentioned in the original description, beyond Szechwan, although in his fuller account in the "Recherches," Milne-Edwards states that he also had specimens from Muping sent to him by David. In his review of the geographic races, however, Thomas (1916a), after comparison with specimens lent by the Paris Museum, regards as typical two from Tsikou in extreme northwestern Yunnan, as well as those sent by Perny from western Szechwan. In a later paper he (1922b) further records specimens from the Mekong-Salween divide at from 7,000 to 10,000 feet, north latitude 28°. Various records from other parts of China are to be considered as relating to the species rather than to the various races. Most of these latter are ill-defined, and only to be determined by careful comparison, and may in part have to be relegated eventually to synonymy. In general the typical race is characteristic of the moist uplands of southern Szechwan and northern Yunnan, perhaps corresponding in its distribution to that of *Callosciurus erythræus bonhotiei*. A specimen from Tatsienlu in the Museum of Comparative Zoölogy doubtless represents this race, in its darker dorsal side and tinge of bright ochraceous over the lower surface, and probably marks nearly the northwestern limit of the subspecies.

Specimens examined:—In all, thirty-seven, namely:

Yunnan: Mekong valley, 2 (B.M.); Mekong-Salween divide, 2 (B.M.); Shweli-Salween divide, 4 (B.M.).

Szechwan: Tatsienlu, 1 (M.C.Z.); Nagechuka (or Hokow), 1, type of *D. pernyi griselda* (B.M.), 4, (M.C.Z.); Ramala Pass, 13,000 feet, 4 (M.C.Z.); Shuowlow, 13,000 feet, 2 (M.C.Z.); Tchoksi, 2 (A.N.S.P.); Mopo Gomba, 1 (A.N.S.P.); Tungling Shan, 1 (A.N.S.P.); Batang, 8 (A.N.S.P.); Horbo, north of Batang, 1 (A.N.S.P.); Tongolo valley, 1 (A.N.S.P.); thirty miles east of Hokow, 2 (A.N.S.P.); Muliting, 1 (A.N.S.P.).

271. *Dremomys pernyi flavior* G. M. Allen

Dremomys pernyi flavior G. M. Allen, Proc. Biol. Soc. Washington, vol. 25, p. 178, 1912.

Dremomys pernyi lichienensis Thomas, Ann. Mag. Nat. Hist., ser. 9, vol. 10, p. 403, 1922.

Type specimen:—A skin and skull from Mengtsz, southeastern Yunnan, No. 13691, Museum of Comparative Zoölogy, collected in 1911 by H. Oriei.

Description:—Distinguished from typical *D. p. pernyi* by its slightly smaller size, the nearly pure white under parts, with but the slightest tinge of buffy on the throat, and the buff central area of the under surface of the tail, combined with the dark olive green of the upper side. The type is a youngish animal, and hence rather small, but Thomas (1916a), with a series of seven in the British Museum, confirms the slightly smaller size, with greatest skull length of 49 mm., "facial length," 25, a difference nevertheless of no great moment. In the specimens at hand the most important distinction seems to be in the slightly brighter color of the central lower side of the tail, which is ochraceous unmixed with gray. A series from the Likiang Range representing typical *D. p. lichienensis* seems to be identical in color with *D. p. flavior*, or at most the least trifle grayer in some individuals, but otherwise indistinguishable from the form found over southeastern Yunnan. These might best represent mere intergrading individuals, and I prefer to treat them as such. Specimens in winter pelage have a distinctly greenish appearance.

Measurements:—A specimen from the Mekong River at 6,000 feet altitude measures practically as in other races of the group: head and body, 180 mm.; tail, 155; hind foot, 51; ear, 23.

CRANIAL MEASUREMENTS OF *DREMOMYS PERNYI FLAVIOR*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
84917	46.5	37.5	22.6	23.2	19.7	10.2	8.3	8.3	Yunnan
84918	48.0	39.5	23.3	24.1	19.8	10.0	8.6	8.8	Yunnan
84921	51.5	42.0	24.8	26.0	21.2	10.5	8.0	8.2	Yunnan
84925	48.6	41.8	24.1	25.0	20.5	10.5	8.8	8.0	Yunnan
84927	49.7	40.6	24.1	24.8	21.0	10.4	8.5	—	Yunnan
Average	48.8	40.2	23.8	24.6	20.4	10.3	8.4	8.3	Yunnan

Occurrence and Habits.—To this race I would refer the *D. pernyi* type of squirrel found over southeastern Yunnan, extending eastward probably, to an undetermined distance. To the southwest it passes by insensible degrees into the slightly more richly colored race, *D. p. howelli*, and to the north into the somewhat paler and grayer subspecies, *D. p. pernyi*. A series from the Likiang Range from altitudes up to 10,000 or even 12,000 feet is not greatly different, and, although named *D. p. lichiensis* by Thomas, is perhaps better regarded as merely intermediate toward the last, a view in which Osgood (1932) and Howell (1929) concur. The American Museum Asiatic Expeditions secured specimens from Kaochow, Fengyang, Hsinkai (southwest of Yunnanfu), from Chunglu on the Mekong River at 6,000 feet, and from Litien and Weisi Pass at 11,000 feet. Others from the Likiang Range are from altitudes of from 8,000 to 10,000 feet. As with many other species, there is little color variation between the skins of lower and higher altitudes here.

Specimens examined.—In all, forty, as follows:

Yunnan: Chunglu, Mekong River, 1; Hsinkai, 1; Kaochow, 2; Fengyang, 3; Litien and Weisi Pass, 11,000 feet, 2; Yangwupa, southwest of Yunnanfu, 2; Wutinghsien, 3; Likiang Range, 8,200 feet, 4 + 16 (B.M.); Likiang, Peishui, 10,000 feet, 6.

272. *Dremomys pernyi howelli* Thomas

Dremomys pernyi howelli Thomas, Ann. Mag. Nat. Hist., ser. 9, vol. 10, pp. 400, 401, 1922.

Type specimen.—A male, skin and skull, No. 12.8.26.2, British Museum, from Machangkai, twenty-five miles southwest of Tengyueh, southwestern Yunnan, China. Collected June 4, 1912, by E. B. Howell.

Description.—In general very much like typical *D. p. pernyi*, or very slightly more yellowish olivaceous, but with an almost imperceptible blackish dorsal line on the fore back from one to two inches long; under surface whitish, the front aspect of the lower legs creamy, or more or less washed with reddish (Thomas, 1922b).

Measurements.—Thomas records the following measurements of the type which are not essentially different from those of the typical race: head and body, 199 mm.; tail, 138; hind foot, 46; ear, 22.

Type skull: greatest length, 53.5 mm.; condylo-incisive length, 45.5; upper tooth row, excluding pm³, 8.1.

Occurrence and Habits.—Although not at all strongly differentiated, this race with its slight tendency to a darkening of the fore back, present in all nine of the original series, is doubtless to be regarded as the subtropical representative of true *D. p. pernyi* in extreme southwestern Yunnan, and according

to its describer, it extends westward into the valley of the upper Irrawaddy. Its eastward range is doubtless not extensive, for the race *D. p. flavior* probably occupies most of southern Yunnan. In its distribution it probably corresponds with the darker race *gordoni* of *Callosciurus erythræus*. To it I have referred a skin from Taipingpu on the Shweli River, and an imperfect skin with skull from the same place in the collection of the American Museum of Natural History.

Specimens examined:—Ten, namely:

Yunnan: Machangkai, 8, including type (B.M.); Taipingpu, Shweli River, 2.

273. ***Dremomys pernyi senex*** G. M. Allen

Dremomys senex G. M. Allen, Mem. Mus. Comp. Zool., vol. 40, p. 229, 1912.

Dremomys pernyi senex Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 17, p. 393, 1916.

Type specimen:—A skin and skull of an adult female, No. 7582, Museum of Comparative Zoölogy, from Nantu, Ichanghsien, Hupeh, China. Collected February 5, 1909, by Walter R. Zappey.

Description:—Dorsal coloring essentially as in typical *D. p. pernyi* and *D. p. flavior*, a minutely ticked ochraceous and black, producing a dull olive effect; ears on their inside and outer rims like the back, but a small post-auricular patch of buffy or white extends upon the outer base. This patch is white in the type and a second specimen, but Thomas notes that it is buffy and well marked in other specimens from Ichang. A narrow buffy eye-ring is present and the cheeks are slightly tinged with ochraceous. Feet like the back. Throat white to the roots of the hairs, anteriorly, but the lower throat and the belly and forearms are gray-based, the former with a faint wash of yellowish buff, which is conspicuous on the border of the thighs. Tail above showing three black bands on the individual hairs, alternating with dull ochraceous buff to drab, and tipped with white; below, the white tips form an external fringe, succeeded by a black border, while the central area is drabby ochraceous. The usual ferruginous patch is present over the anal region, extending to the upper part of the hind legs.

Measurements:—The following measurements made by the collector on the fresh specimens indicate a slightly greater size than in the western races (those of the type are given first in each case): total length, 373, 375 mm.; tail, 171, 176; hind foot, 54, 52.

The cranial dimensions are: greatest length, 53, 54.3 mm.; basal length, 43, —; palatal length, 25, 26.7; zygomatic width, 27, 28.2; mastoid width, 20.3, —; width across molars, 11.9, 11.6; upper cheek teeth, 9.2, 9.0; lower cheek teeth, 9.8, 9.0.

Occurrence and Habits.—This race of the middle Yangtze is not at all sharply marked, but differs in the gray-based hairs of the under side of the forearms, and in the very slight wash of yellow below from typical *D. p. pernyi*. The white ear-patches prove to be in other specimens buffy, hence are less distinctive than originally supposed. In addition to the two original specimens from near Ichang, Thomas mentions eight others from the same locality in the British Museum. These I have compared with the British Museum series from other localities in southeastern China, and find them so nearly the same that I doubt very much if further collecting will bear out differences sufficient to warrant their separation. The reddish brown of the under side of the tail is rather characteristic of these and the series from Kuatun, which Thomas has described as *D. p. calidior*.

Specimens examined.—Nine, including the type and one other from the vicinity of Ichanghsien, Hupeh (M.C.Z.), and seven from Ichang (B.M.).

274. ***Dremomys pernyi modestus* Thomas**

Dremomys pernyi modestus Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 17, p. 393, 1916.

Type specimen.—An adult male, skin and skull, No. 8.8.11.41, British Museum, from Suiyang, Kweichow, China. Collected by F. W. Styan in April, 1898.

Description.—"Fur rather harsher than in the western and more highland subspecies. General colour more drabby brown, near 'Saccardo's umber,' the type even approaching 'buffy brown.' Ear-patches comparatively inconspicuous, scarcely contrasting at all with the colour of the head. Under surface distinctly tinged with buffy, especially posteriorly. Middle area of underside of tail dull buffy" (Thomas, 1916a).

The skull is apparently quite like that of neighboring races.

Measurements.—In the original description, Thomas gives the following cranial dimensions: greatest length of skull, 52 mm.; facial length, 26.5; length of brain case, 27; upper tooth series, exclusive of the minute pm³, 8.4.

Occurrence and Habits.—Nothing is known of this race beyond what Thomas has recorded as to its presence at the type locality, Suiyang in Kweichow. The three specimens of the original series he regards as most like *D. p. senex* of the middle Yangtze valley, but paler with less conspicuous ear patches. They are perhaps to be regarded as the same, for after examining the original series at the British Museum, I can see no very obvious characters.

Specimens examined.—Three, namely:

Kweichow: Suiyang, 2, including the type (B.M.); Wenshanchiang, 1 (B.M.).

275. *Dremomys pernyi calidior* Thomas

Dremomys pernyi calidior Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 17, p. 394, 1916.

Funambulus pernyi Thomas, Proc. Zool. Soc. London, 1898, p. 772.

Dremomys pernyi chintalis Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 17, p. 394, 1916.

Type specimen.—A young-adult male, skin and skull, No. 99.3.9.17, British Museum, from Kuatun, northwestern Fukien, China. Collected by F. W. Styan.

Description.—This is a darker race, more ruddy above, the tail distinctly deeper ochraceous below where it is only buffy in the western races. General color above a warmer brown than in the western races, approaching "olive brown"; ear-patches mixed white and ochraceous, or wholly ochraceous. Under surface whitish, usually with well-marked buffy thigh patches. The inside of the ears may also be ochraceous.

The skull is not different from that of the neighboring races.

Measurements.—The following dimensions were taken from fresh specimens by the collector:

No.	Head and body	Tail	Hind foot	Ear	Locality
84479	185	151	45	22	Fukien
84481	212	160	42	19	Fukien
84484	210	155	45	20	Fukien
84488	190	144	44	24	Fukien
84490	193	175	45	22	Fukien
84492	197	152	40	22	Fukien
84495	196	130	43	22	Fukien

CRANIAL MEASUREMENTS OF *DREMOMYS PERNYI CALIDIOR*

No.	Greatest length	Basal length	Palatal length	Zygomastic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
84478	50.5	41.1	24.7	26.4	21.0	11.0	8.5	8.5	Fukien
84479	51.0	42.5	25.5	26.4	21.5	11.2	9.0	8.7	Fukien
84483	48.0	39.5	24.0	24.5	20.2	11.0	9.5	9.0	Fukien
84484	51.4	42.0	25.5	26.1	21.0	10.5	9.0	8.8	Fukien
84486	—	41.0	24.8	25.1	20.0	11.0	8.8	8.4	Fukien
84487	50.0	42.5	25.1	26.7	20.6	10.6	8.8	8.5	Fukien
84490	51.3	42.6	25.8	26.8	22.0	10.8	9.0	9.0	Fukien
94495	51.4	42.6	25.8	26.9	22.0	11.0	9.1	9.0	Fukien
Average	50.5	41.7	25.1	26.1	21.0	10.8	8.9	8.7	

Occurrence and Habits.—The long-nosed squirrel of southeastern China is of a distinctly richer, warmer brownish olive above and a deeper tint of ochraceous on the under side of the tail and on the ears than the more western races, although in general appearance it is very similar to them. Indeed, all the recognized subspecies are remarkably alike, differing only in the average intensity of their coloration, when series from various parts of the general range

are minutely compared. Hitherto the species has been recorded from only Fukien of the coastal provinces, first by Thomas (1898, p. 772), who states that La Touche and Rickett found it common in forests at 3,000 to 4,000 feet about Kuatun in the northwestern part of the province. In 1926 Mr. Clifford H. Pope collected a large series in the same region at Chunganh sien, where he found it common in the high forests. It is more difficult to secure in this denser growth than the Red-bellied Squirrel (*Callosciurus*) which lives in more open country. He could find no trace of it in Futsing, but Cabrera (1922) has recorded four obtained near Foochow. South of this region it has not been detected, nor is anything known of its habits.

After examining the series of five skins from Chinteh, Anhwei, in the British Museum, described by Thomas in 1916 as a new race, *D. p. chintalis*, I fail to see any valid difference between them and the series from Fukien, and am therefore including this name in the synonymy of *D. p. calidior* which in turn is hardly different from *D. p. senex*.

Specimens examined:—In all, thirty-eight, as follows:

Fukien: Kuatun, 14, including the type (B.M.); Chunganh sien, 19.

Anhwei: Chinteh, 5, including type of *D. p. chintalis* (B.M.).

276. *Dremomys rufigenis pyrrhomerus* (Thomas)

RED-THIGHED SQUIRREL

Sciurus pyrrhomerus Thomas, Ann. Mag. Nat. Hist., ser. 6, vol. 16, p. 242, 1895.

Zetis pyrrhomerus Thomas, Journ. Bombay Nat. Hist. Soc., vol. 18, p. 245, 1908.

Dremomys pyrrhomerus G. M. Allen, Mem. Mus. Comp. Zool., vol. 40, p. 228, 1912.

Dremomys rufigenis pyrrhomerus Robinson and Kloss, Records Indian Mus., vol. 15, p. 237, 1918.

Type specimen:—An adult female, skin and skull (number not given), in the British Museum, from Ichang, Hupeh, China. Collected in November, 1893, by F. W. Styan.

Description:—Upper surface of the head, outside of the ears, and the entire back, including the upper part of the limbs and feet, a dark olivaceous, consisting of longer and shorter hairs, each with a slaty base, a very narrow subterminal ring of pale ochraceous, and a longer or shorter black tip, the resulting mixture giving a minutely ticked effect. On the feet the black predominates, but the upper surface of the hind limbs is more ochraceous than black. A small post-auricular buffy spot. The sides of the muzzle and the chin are more ochraceous, the latter clear, pale ochraceous without mixture of black. The mixed dorsal coloration encroaches slightly on the belly, the middle portion of which, from chin to anus, and the inner sides of the hind legs, are buffy white. The under side of the fore legs is gray, only slightly tipped with whitish. A prominently contrasting bright-rufous spot on the thighs extends from the outer side of the hips to the knee or slightly below. The upper side of the tail

is like the back at its extreme base, but beyond this the hairs are long and black with two rather narrow pale rings of buffy gray, tipped with white; the alternating black and gray rings tend to form indistinct transverse bands. The lower side of the tail is strongly contrasted with the upper, its entire central portion being a bright rufous, narrowly bordered with black, and slightly fringed with white. The rufous extends forward as an ochraceous wash to the center of the inguinal region.

The skull is notable for the very long tapering rostrum, the length of which from the tip of the nasals to the orbit exceeds the mastoid width and nearly equals the zygomatic width. In profile view the brain case is convex upward just back of the middle of the orbits, and the basicranial axis is bent strongly downward at the hind edge of the palate.

Measurements.—The following external measurements were taken in the field by the collector:

No.	Head and body	Tail	Hind foot	Ear	Sex	Locality
58249	205	155	55	23	♂	Szechwan
58244	195	140	52	24	♂	Szechwan
58245	210	160	54	24	♂	Szechwan
58247	205	150	50	24	♂	Szechwan
58255	206	145	52	24	♂	Szechwan
56821	195	152	50	22	♀	Szechwan
56823	198	152	50	22	♀	Szechwan
58246	195	155	55	24	♀	Szechwan
58251	202	162	53	22	♀	Szechwan
58263	206	160	52	23	♀	Szechwan

CRANIAL MEASUREMENTS OF *DREMOMYS RUFIGENIS* RACES

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Orbit to tip of nasals	Upper cheek teeth	Lower cheek teeth	Locality
<i>D. rufigenis pyrrhomerus</i>										
58249	—	—	28.5	30.6	—	12.6	28.6	9.0	9.3	Szechwan
58256	55.3	46.1	27.5	28.7	22.5	12.0	25.9	9.9	9.7	Szechwan
58259	58.0	48.4	28.5	30.2	23.6	12.1	27.6	9.5	9.2	Szechwan
58260	56.8	47.8	28.6	31.7	23.5	12.7	28.2	9.5	9.4	Szechwan
84360	56.1	48.0	28.5	31.0	23.0	12.5	25.8	9.5	9.4	Szechwan
7117 MCZ	56.3	45.9	27.6	30.0	22.0	12.5	26.5	9.8	9.7	Hupeh
7116 MCZ	56.5	46.8	27.5	30.5	23.4	11.8	27.6	9.8	9.6	Hupeh
7569 MCZ	57.8	48.5	28.6	30.5	23.1	11.7	27.8	8.7	9.6	Hupeh
<i>D. rufigenis riudonensis</i>										
26649	—	—	—	29.8	—	11.0	—	9.6	9.6	Hainan
26650	—	—	27.5	(27.5)	—	11.2	—	10.0	9.6	Hainan
26652	—	—	25.5	27.8	—	11.5	—	10.5	9.5	Hainan
26653	—	39.3	24.3	(25.0)	20.3	11.7	—	10.2	9.9	Hainan

Occurrence and Habits.—This handsome squirrel with its bright rufous thigh-spot and under side of tail is known only from the middle Yangtze: in the mountains about Ichang, Hupeh, where it was first obtained by F. W. Styan in 1893 and again by W. R. Zappey in 1907; as well as in extreme eastern Szechwan at Wanhsien, and slightly to the south at Sinyang in northern Kweichow. It is apparently the most northern member of the species. First described as a distinct species by Thomas, it was later placed by Robinson and Kloss (1918) as a race of *Dremomys rufigenis* to which it is undoubtedly closely related. Osgood (1932) inclines to maintain its specific distinctness from the latter, but it seems likely that the two will be found to intergrade when more specimens are secured from the different parts of the range in southern China. It is a forest-living species of the mountain country, but nothing seems to have been recorded of its habits. It was apparently common about Wanhsien in eastern Szechwan, where Dr. Walter Granger secured a fine series in 1921-26.

Specimens examined.—In all, thirty-eight, from the following localities:
Hupeh: Changyanghsien, 2 (M.C.Z.); Tongkowshih, 1 (M.C.Z.).
Szechwan: Wanhsien, 35.

277. *Dremomys rufigenis riudonensis* (J. A. Allen)

Funambulus riudonensis J. A. Allen, Bull. Amer. Mus. Nat. Hist., vol. 22, p. 472, 1906.

Dremomys rufigenis riudonensis Robinson and Kloss, Records Indian Mus., vol. 15, p. 237, 1918.

Type specimen.—A female adult, skin and skull, No. 26651, American Museum of Natural History, from Riudon, island of Hainan, China. Collected March 11, 1903.

Description.—This race differs from *D. r. pyrrhomerus* in having the sides of the head rich red, while the red of the under surface of the tail extends over the anal region. In addition the postauricular patch is white instead of buff. The dorsal region is dark olivaceous brown, the individual hairs black "narrowly annulated near the middle with yellow, and with a short yellow tip, mixed with a few hairs black-tipped or wholly black; whole upper aspect of head reddish chestnut finely punctuated with black; sides of the head, from the nose posteriorly, uniform deep chestnut red . . . ventral surface superficially white or faintly yellowish white, with the basal portion of the fur dusky; sides of neck, shoulders, and outer surface of fore limbs reddish, varied slightly with black-tipped hairs; front of thighs and inside of hind limbs deep reddish chestnut, the outside reddish brown varied with black-tipped hairs; feet dark, tinged with reddish brown, the hind feet a little darker and redder than the front feet; ears thinly clothed, dark brown tinged slightly with reddish, with a large fluffy spot of soft white fur at the outer base; tail above blackish, the hairs tipped

and annulated basally with dull white; lower surface of tail deep chestnut, bordered narrowly with black and slightly fringed with white. The red on the sides of the head and neck, the large deep red area on the front of the thighs, and the red under surface of the tail are the conspicuous features of the coloration, to which may be added the red head in striking contrast with the dark olive brown back" (J. A. Allen, 1906, p. 472).

Measurements.—No flesh measurements are available. A well-made skin of the original series measured: total length, 305 mm.; head and body, 170; tail, 135; hind foot, 45.

The skulls of the original series are all imperfect, but sundry measurements are given in the table under *D. r. pyrrhomerus*.

Occurrence and Habits.—The original series of this squirrel from Riudon on the island of Hainan constitutes all the recorded specimens. These were obtained by native collectors working for the dealer Alan Owston, and evidently represent an uncommon, perhaps local, mountain species. Mr. Clifford H. Pope, in the course of his extensive work on the island, did not meet with it, and it was unknown to Swinhoe. It seems to differ from the Yunnan and Tongking form in its redder occiput and fore limbs and the white postauricular patch. No doubt it will eventually be found to be closely related to the form *D. r. melli* of the adjacent mainland.

Specimens examined.—The original series, including the type, five, from Riudon, Hainan.

278. *Dremomys rufigenis melli* Matschie

Dremomys melli Matschie, in Mell, Arch. f. Naturg., vol. 88, sect. A, pt. 10, pp. 23, 37, 1922.

Type specimen.—The type is a skin (?skull) in the Zoologisches Museum, Berlin, female, No. 854 (?original number), from mountains east of Siudsau, Kwangtung, China. Collected by R. Mell.

Description.—According to Matschie's description, this squirrel is somewhat intermediate in color between *D. rufigenis rufigenis* and *D. r. pyrrhomerus*, having the conspicuous rusty-red spot on the outer side of the hips as in the latter, but the cheeks and sides of the neck deep rusty as in the former. There is a white postauricular patch, and the belly is whitish gray. This is probably a valid race, serving to connect *D. r. pyrrhomerus* with the subspecies *D. p. gularis* Osgood of Tongking; it is apparently not very different from the race found on Hainan.

Measurements.—No data are available as to the dimensions of skull or body.

Occurrence and Habits.—All that is certainly known of this squirrel is the statement of Mell (1922) that it is very local, and was apparently found by him on only a single mountain mass, east of Siudsau, Kwangtung, in north latitude 25°, and at altitudes of between 600 and 900 meters, or in winter slightly lower. It is an arboreal species, though coming often to the ground to feed, even visiting native gardens for millet. Possibly Shih (1930, p. 5) refers to this squirrel in mentioning that "*Sciurus rufigenis*" is apparently common in the Yao Shan area of Kwangtung.

Specimens examined.—None.

279. ***Dremomys rufigenis ornatus* Thomas**

Dremomys rufigenis ornatus Thomas, Journ. Bombay Nat. Hist. Soc., vol. 23, p. 26, 1914.

Type specimen.—An old female, skin and skull, No. 12.7.25.20, British Museum, from Yunnan, China, probably from near Mengtsz. Collected in February by H. Orii.

Description.—According to its describer, this squirrel differs from the typical race of *D. rufigenis* by its greater skull length and long muzzle. The general coloring is a finely mixed ochraceous and black above, with brighter, nearly clear ochraceous cheeks and a buffy spot at the back of the ear. The under surface of the body is white; the chin and throat more or less washed with pale ochraceous; that of the tail bright rusty red, conspicuously fringed with white tips and a subapical band of black. In some specimens the under surface of the hind legs is rusty red, and the border of the thighs may be the same.

Measurements.—The size is about the same as in the *D. pernyi* group, hind foot, 44 mm.

The skull is larger, that of the type 58.2 mm. in greatest length.

Occurrence and Habits.—Almost nothing is known of this squirrel in Yunnan beyond the fact of its presence on the extreme southern border. Quite recently, Osgood (1932, p. 282) has reported on a series from northern Laos and Tongking to the southward, and regards the slight ochraceous wash of the under side, though variable in intensity, as one of the distinguishing points as compared with the typical race.

Specimens examined.—None.

Genus ***Sciurotamias* Miller**

Sciurotamias Miller, Proc. Biol. Soc. Washington, vol. 14, p. 23, 1901.

Sciurus Milne-Edwards, Rev. et Mag. de Zool., ser. 2, vol. 19, p. 196, 1867; Recherches pour servir à l'Hist. Nat. des Mammifères, p. 160, 1868-74 (in part).

Xerus Trouessart, Cat. Mamm. Viv. Foss., p. 410, 1897 (in part).

In 1867 when describing *Sciurus davidianus*, the type species of this genus, Milne-Edwards regarded it as belonging to the subgenus *Tamias*, as then understood, which it resembles in the possession of small though distinct cheek pouches and in its subterranean habits. He recognized, however, that its form was much more like that of the tree squirrels, and considered it as an intermediate type. Trouessart in 1897 referred it to the genus *Xerus*, now applied only to the African ground squirrels, and placed it with *Rhinosciurus laticaudatus* in the subgenus *Rhinosciurus*, on account doubtless of its elongated rostrum. In 1901, however, Miller definitely made it the representative of a distinct genus *Sciurotamias*, and was inclined to regard it as related to *Eutamias*. Nevertheless, it bears a number of resemblances to *Dremomys* in its lengthened rostrum, small depressed postorbital processes, generally gray type of pelage, and the bushy tail in which the white-tipped hairs are prominent on the upper side while the lower side has a pale-ochraceous central area much as in *Dremomys pernyi*. In addition, the mammæ are but six, one pair pectoral, two pairs inguinal. The characters of the baculum seem to be unrecorded, but probably would be like those of *Dremomys*, to which the genus seems to be most closely allied, and of which it is the terrestrial derivative. It differs chiefly, apart from the possession of cheek pouches (so often developed with underground habits in rodents), in having the brain case very much more flattened, so that not only is the zygomatic width greater in proportion, being more than half the total length of the skull instead of one-half that dimension, but it is much flatter, with the basicranial angle much less and the audital bullæ not projecting nearly as far ventrally. The rostrum, though elongate, is less so than in *Dremomys*. The tooth formula is the same in both, but in *Sciurotamias* the minute anterior premolar of the upper jaw is even smaller, partly overhung by the larger posterior one, so that its crown may not even reach the level of those of the rest of the series. The enamel ridges on the four succeeding teeth are as usual, two each in profile view on the three anterior teeth, one on the last, but they are low as compared with those of *Dremomys*. In contrast to the latter genus, the soles of the hind feet are densely haired as far as the rounded pads beneath the bases of the proximal phalanges, so that the elongate metatarsal pads are lacking.

A single species is known from the northern half of China, with three geographical races which may be distinguished by the following key.

KEY TO THE CHINESE RACES OF *Sciurotamias*

- A. Entire under parts grayish white, faintly washed with buff. *S. davidianus davidianus*
- B. Under parts washed with ochraceous.
 - a. Ochraceous tints paler, hind feet colored like the back. *S. davidianus saltitans*
 - b. Ochraceous tints richer, hind feet black. *S. davidianus consobrinus*

280. *Sciurotamias davidianus davidianus* (Milne-Edwards)

PÈRE DAVID'S ROCK SQUIRREL

Sciurus davidianus Milne-Edwards, Rev. et Mag. de Zool., ser. 2, vol. 19, p. 196, 1867.

Sciurus (Tamias) davidianus Milne-Edwards, Recherches pour servir à l'Hist. Nat. des Mammifères, p. 160, pl. 16; pl. 18, fig. 2, 1868-74.

Xerus davidianus Trouessart, Cat. Mamm. Viv. Foss., p. 410, 1897.

Dremomys latro Heude, Mém. concern. l'Hist. Nat. de l'Emp. Chin., vol. 4, pt. 2, p. 55, pl. 12, figs. 1-1c, 1898.

Sciurotamias davidianus Miller, Proc. Biol. Soc. Washington, vol. 14, p. 23, 1901.

Type specimens.—The species is based on two specimens sent by Père Armand David to the Muséum d'Histoire Naturelle at Paris, from the "montagnes de Pekin," Hopei, China. According to Jentink (1883) one of these cotypes is in the Leiden Museum, Holland.

Description.—An adult female taken in mid-April at Tungling, Hopei, and therefore a virtual topotype, has the entire dorsal surface of the head and body a pale gray, resulting from an even mixture of black-tipped hairs with their

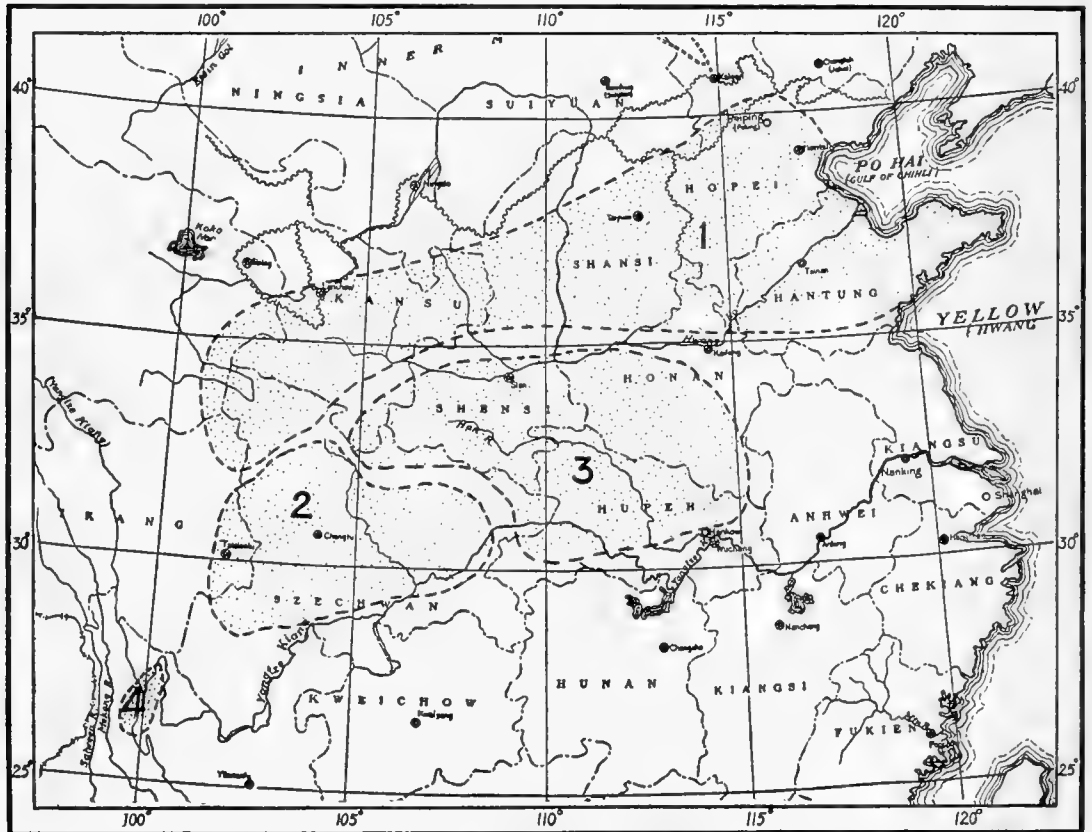


FIG. 26. Distribution Map.

- Sciurotamias*
 1. *S. davidianus davidianus*
 2. *S. davidianus consobrinus*
 3. *S. davidianus saltitans*

- Rupes*
 4. *R. forresti*

subterminal pale-ochraceous rings and other hairs all black. The feet, cheeks, and tail are of practically the same tint, the last with longer hairs of which the basal three-quarters is pale buffy gray, then a narrower black ring and a grayish-white tip. A well-defined ring of pale buffy surrounds the eye. The ears are clothed with very short hair, nearly black, but slightly mixed with buffy. Behind each ear is a whitish patch which extends backward as a short but very ill-defined stripe. Entire lower surface of the body and limbs whitish, faintly washed with buffy. Lower side of tail scarcely different from the upper. The sides of the head below the eye are distinctly blacker than the buffy area above and below them.

The flattened wide skull and small bullæ, as well as the smaller upper first premolar, are in contrast to these characters in *Dremomys*.

Measurements:—In addition to the measurements given for the original specimen, the following are from fresh specimens taken in the field by the collector.

No.	Head and body	Tail	Hind foot	Ear	Locality
(cotype)	230	200	—	—	Hopei
45370	220	135	50	20	Shansi
45371	195	140	50	20	Shansi
45303	230	—	55	—	Hopei
45305	215	138	51	25	Hopei
45306	225	138	53	25	Hopei

CRANIAL MEASUREMENTS OF *SCIUROTAMIAS DAVIDIANUS*

No.	Greatest length	Basal length	Palatal length	Zygomastic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
<i>S. davidianus davidianus</i>									
45300	—	46.5	27.4	29.6	23.0	13.5	9.0	—	Hopei
42372	53.7	45.8	27.2	28.8	23.0	13.7	9.1	9.1	Shansi
70.7.18.22 BM	54.6	45.7	26.0	29.0	25.0	13.5	9.1	9.3	Hopei
19.12.22.5 BM	54.8	46.5	26.9	28.3	23.5	13.4	9.7	9.5	Hopei
19.12.22.6 BM	55.5	45.7	27.8	29.4	24.0	13.2	9.0	9.2	Hopei
19.12.22.7 BM	57.0	48.9	28.8	30.7	24.1	13.8	9.3	9.7	Hopei
10.12.26.1 BM	55.0	47.7	27.8	31.0	23.5	14.4	8.5	8.5	Hopei
8.8.7.26 BM	54.0	45.0	26.8	29.5	24.5	13.7	8.6	8.5	Shansi
9.1.1.20 BM	55.8	47.6	27.9	29.4	23.8	13.4	8.9	9.1	Shansi
9.1.1.23 BM	52.6	43.8	26.0	28.1	22.1	12.9	8.1	8.6	Shensi
<i>S. davidianus consobrinus</i>									
8008 MCZ	56.4	47.5	28.5	29.7	23.2	13.3	9.3	9.2	Szechwan
11.2.1.90 BM	55.5	48.0	29.1	29.5	22.7	13.6	9.2	9.2	Szechwan
96.11.4.3 BM	55.7	46.2	27.7	29.7	23.2	13.6	8.5	9.0	Szechwan
11.2.1.93 BM	54.2	43.9	26.5	28.3	22.9	13.5	9.0	8.9	Szechwan

CRANIAL MEASUREMENTS OF *SCIUROTAMIAS DAVIDIANUS* (Cont'd)

No.	Greatest length	Basal length	Palatal length	Zygomastic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
<i>S. davidianus saltitans</i>									
13.9.13.5 BM	56.8	47.0	26.9	30.6	23.7	—	8.6	8.3	Huieh
7108 MCZ	56.1	46.9	27.7	30.8	24.7	13.1	9.2	9.0	Huieh
7111 MCZ	57.3	48.6	28.3	31.0	25.2	14.1	9.1	8.8	Huieh
7113 MCZ	56.0	46.2	27.4	29.6	23.0	13.2	8.8	8.5	Huieh
7114 MCZ	52.3	41.6	24.9	27.9	22.7	12.8	8.0	8.7	Huieh
7115 MCZ	56.3	47.5	28.4	29.5	—	13.2	9.3	9.1	Huieh

There seem to be no important differences in cranial characters among the different races, so far as the material at hand shows.

Nomenclature.—Of the three names given by Père Heude to squirrels of this genus, one, *Dremomys latro*, is evidently based on the form found in Shantung, although this is by implication only. It does not seem to be different from typical *S. davidianus* to judge by the description—"un peu de gris sale sous le menton, le dessous et le dedans des cuisses sont grisâtres."

Occurrence and Habits.—The gray rock squirrel with nearly white belly is found from the mountains about Peiping in Hopei southward into the Shantung peninsula and westward into extreme western Kansu, and is thus the most northern of the three subspecies. I have been unable to detect any differences of importance between the specimens from these eastern and western extremes of its range. Dr. Roy Chapman Andrews secured a fine series of this squirrel from the Eastern Tombs (Tungling) region of Hopei, which are thus practically topotypes. In addition he secured three at Heshuin in Shansi, and Jacobi (1922, p. 12) records one from the middle part of the same province. Thomas has recorded it from one hundred miles north of Taiyuanfu and (1909) from fifteen miles north of Fenchowfu, twenty miles southwest of Ningwufu, Shansi, as well as near Yenanfu, Shensi. Farther west, he (1911d) mentions a female from forty miles north of Kaichow, Kansu, while Buechner (1892, p. 155) writes that it is common in the southern mountainous parts of Kansu, on rocky ground, avoiding tree growth. The local native name is said to be "ngei-loú-tschu" or Rock Mouse. Sowerby (1914, p. 76) regards it as a common species all over North China in mountainous and hilly regions, and mentions its large cheek pouches. He adds, "Though it can climb trees, it is more of a rock and cliff inhabiting species, nesting in deep cracks and crannies. I found these squirrels extremely plentiful in the mountains of south Shensi. Here the natives told me they form a regular pest, and are as bad as rats in the way they enter the houses and steal grain and food." M. P. Anderson, in his notes supplied to Oldfield Thomas (1909), also speaks of its fondness for rocky,

precipitous sides of canyons where bushes are plentiful and where there are a few trees. He found it eating the kernel of the wild peach. Three specimens were secured by Dr. J. F. Rock in extreme southwestern Kansu at Wantsangku, Na Tebbuland, that seem perfectly typical. Probably this is near the western limit of the range, at the borders of the Tibetan plateau. Intergradation with the races following undoubtedly takes place in southern Shensi and northern Szechwan. A. B. Howell (1929), in recording various specimens in the U. S. National Museum from localities just west of Peiping, near Taiyuanfu and Wutai, Shansi, makes note of one from Yen-anfu, Shensi, which "varies toward" the race of Tsingling and of Hupeh, described as *Sciurotamias owstoni* by J. A. Allen. The range apparently follows down on the western edge of Szechwan a certain distance, for Osgood (1932, p. 281) records two specimens from Kochiahopa and Trashichotin that seem "quite typical of *davidianus*," although these localities are northeast of Tatsienlu and "but a short distance almost directly west of Mouping." Three skins collected by Mr. Brooke Dolan for the Academy of Natural Sciences of Philadelphia, coming from Tietschi in the upper Min valley, northern Szechwan, and a fourth from east of Romitchangu are nearest the typical race, though in the slightly more buff under side showing an approach to *S. d. consobrinus*.

Specimens examined:—In all, thirty-eight, as follows:

- Hopei: Eastern Tombs, 12 + 1 (B.M.); hills north of Chinwangtao, 1 (B.M.); Wawayü Mountains, 3 (B.M.); Peiping, 2 (B.M.).
 Shansi: Heshuin, 3; fifteen miles northwest of Fenchowfu, 2 (B.M.); one hundred miles northwest of Taiyuanfu, 1 (B.M.); Husien, 1 (B.M.).
 Shensi: north of Yen-anfu, 4 (B.M.).
 Kansu: forty miles north of Kaichow, 1 (B.M.); Na Tebbuland, Wantsangku, 3 (M.C.Z.).
 Szechwan: upper Min valley, 3 (A.N.S.P.); east of Romitchangu, 1 (A.N.S.P.).

281. *Sciurotamias davidianus consobrinus* (Milne-Edwards)

BLACK-FOOTED ROCK SQUIRREL

Sciurus consobrinus Milne-Edwards, Recherches pour servir à l'Hist. Nat. des Mammifères, p. 305, 1868-74.
Dremomys collaris Heude, Mém. concern. l'Hist. Nat. de l'Emp. Chin., vol. 4, pt. 2, p. 55, pl. 12, figs. 2-2c, 1898.
Sciurotamias davidianus consobrinus Thomas, Proc. Zool. Soc. London, 1911, p. 169.
Sciurotamias davidianus (sic) thayeri G. M. Allen, Mem. Mus. Comp. Zool., vol. 40, p. 231, 1912.
Sciurotamias davidianus thayeri Jacobi, Abh. u. Ber. Mus. f. Tier- u. Völkerk., Dresden, vol. 16, no. 1, p. 13, 1922.

Type specimen:—The original specimen to which this name was given in the catalogue of the Muséum d'Histoire Naturelle at Paris came from Muping, central Szechwan, China, whence it was sent by Père Armand David. Milne-Edwards himself wrote that, although he named it *Sciurus consobrinus* in the catalogue of the Museum, he doubted the propriety of regarding it as new on the basis of the single specimen.

Description:—Forehead, crown and back a general dark brownish oliva-

ceous, due to a fine mixture of brownish ochraceous and black, slightly less brown over the shoulders. A narrow light-ochraceous eye-ring; the area between the eye and the ear, and the lower edge of the cheeks mixed with deep ochraceous, the two areas separated by an ill-defined blackish stripe. Backs of the ears and the upper surface of the hind feet black. A smoky white tuft behind the ear, continued posteriorly as a short paler streak on each side of the neck. Under surface of the body, except for a varying amount of pure white in the middle of the throat, a rich ochraceous, the hairs slaty at their bases. Tail with its central area formed by the bases of the long hairs, pale rusty, bordered by black, and fringed with scattered white tips.

The skull is apparently not different from that of typical *S. d. davidianus*.

Measurements:—The measurements in the flesh of M.C.Z. No. 8008 (type of *S. d. "thayeri"*) are: total length, 363 mm.; tail, 148; hind foot, 54.

For cranial measurements, see the table under *S. d. davidianus*.

Nomenclature:—Notwithstanding Milne-Edwards's doubt as to the validity of this race, it is nevertheless very well marked, as was recognized independently in 1898 by Père Heude, who contrasted the Szechwan animal with that of Hopei and the middle Yangtze, and pointed out the difference in color, especially of the under side, and figured the teeth. His name *Dremomys collaris*, however, is long antedated. It now proves, also, that the specimen I named *S. d. thayeri* in 1912 is the same and differs in its richer coloring and black hind feet from the Hupeh specimens then taken to be typical of *S. davidianus consobrinus*. This was recently recognized also by Osgood (1932) who had a topotype from Muping.

Occurrence and Habits:—This richly-colored race is typical of the damp highlands of Szechwan, but the exact range is still to be worked out. The original specimen was from Muping, and Osgood (1932) has recorded it from Tupakeo, immediately northwest of that region. Thence it extends southward to the Wa Shan region, whence the type of *S. d. "thayeri"* came, and Thomas (1911d) has recorded it from Tatsienlu ("not very typical") and from Omei Shan in the central part of the province. Jacobi (1922) reports it from Sungpan, still farther to the north, as well as from Tatsienlu, but those from the former locality may be intermediate between this and typical *S. d. davidianus*, for Howell (1929) refers specimens from Sungpan to *S. d. "owsteni"*.

Jordan and Rothschild (1911) have recorded from this squirrel three new species of flea: *Ceratophyllus crispus*, *C. euteles*, and *C. phæopis*.

Specimens examined:—Twelve, as follows:

Szechwan (including Hsikang): twenty-three miles southeast of Tatsienlu, 3 (B.M.), 1 (A.N.S.P.); Omei Shan, 1 (B.M.); Wenchwanhsien, Si Ho, 1 (B.M.); Lunganfu, 2 (B.M.); Yangliupa, 3 (B.M.); Wa Shan, 1, type of *S. d. thayeri* (M.C.Z.).

282. *Sciurotamias davidianus saltitans* (Heude)

- Dremomys saltitans* Heude, Mém. concern. l'Hist. Nat. de l'Emp. Chin., vol. 4, pt. 2, p. 55, pl. 12, figs. 4-4c, 1898.
Sciurus davidianus De Winton and Styan, Proc. Zool. Soc. London, 1899, p. 577 (in part).
Sciurotamias owstoni J. A. Allen, Bull. Amer. Mus. Nat. Hist., vol. 26, p. 428, 1909.
Sciurotamias davidianus consobrinus G. M. Allen, Mem. Mus. Comp. Zool., vol. 40, p. 231, 1912 (not of Milne-Edwards).
Sciurotamias davidianus owstoni G. M. Allen, Amer. Mus. Novitates, no. 163, p. 8, 1925.
Sciurotamias davidianus owstoni A. B. Howell, Proc. U. S. Nat. Mus., vol. 75, art. 1, p. 39, 1929.

Type specimen.—Although no type is mentioned in the original brief description, the specimen from which Père Heude's figures were drawn may be at the Sikawei Museum in Shanghai. It came from Hupeh apparently.

Description.—Similar in general appearance to the typical race of northern China, except that the entire upper parts are distinctly tinged with brown, a result of the deeper ochraceous tint of the pale rings of the hairs. The region of the shoulders and neck, however, is appreciably paler or grayer than the rest of the back. The backs of the hind feet are similar to the back in color. On the ventral side, the throat and mid-ventral region are strongly suffused with pale ochraceous, in contrast to the whitish with a faint buffy wash of typical *S. d. davidianus*. The same difference is found in the color of the under side of the tail, which is deeper in its pale-ochraceous tint, with fewer white-tipped hairs. There is also a spot on the upper throat in most specimens, of varying size, in which the hairs are clear white to their roots.

Measurements.—The following dimensions were taken from the fresh specimens in the field:

No.	Total length	Tail	Hind foot	Locality
7111 MCZ	375	145	56	Hupeh
7112 MCZ	310	125	55	Hupeh
7113 MCZ	360	140	56	Hupeh
7114 MCZ	320	133	53	Hupeh
7115 MCZ	340	120	59	Hupeh

The size and cranial characters show no important deviations from those of the typical *S. d. davidianus*. For measurements of the skull, see table under the latter.

Occurrence and Habits.—In proposing the name *saltitans* for this race, Père Heude stated that it was found from the region of the larger mountains of the eastern highlands of Hupeh eastward into northwestern Anhwei. It is the form also of southern Shensi in the Tsingling Mountains, and A. B. Howell (1929) has recorded a specimen in the U. S. National Museum from Hwangtsaopa, Kweichow. These localities outline in a general way the known range at present, from which it seems that it occurs chiefly to the north of the Yangtze River. Specimens from Taipai Shan, Tsingling Mountains, were made the

basis of J. A. Allen's *S. owstoni*, but Heude's earlier name applies to the same race. In the British Museum is a series from Shangchow, southern Shensi. Additional localities listed by Howell are: for Shensi, Luitsuen near Sianfu, and near Chingchienhsien; for Szechwan, Wenchwan, Sungpan, and Ludinchiao, but doubtless some of these, such as those from Szechwan, are intergrades with *S. d. davidianus* or *S. d. consobrinus*. Three were secured by the Central Asiatic Expeditions forty-five miles south of Fengsiangfu in Shensi. The series from Hupeh that I (1912) previously recorded as *S. d. consobrinus* is also referable to this race. Of the habits practically nothing is recorded, except that it is a mountain species living in rocky areas where there is more or less bushy cover or thin tree growth.

Specimens examined:—In all, forty, namely:

Hupeh: Tansheoya, 1; Hsingshanhsien, 2; Chiliping, Fong Shan, 1; Musweiping, 1; Mafuling, 2.

Shensi: forty-five miles south of Fengsiangfu, 3; Tsingling Mountains, base of Taipai Shan, 13; Shangchow district, 14 (B.M.); Lonanhsien, Tsingling Mountains, 3 (B.M.).

Genus *Rupestes* Thomas

Rupestes Thomas, Ann. Mag. Nat. Hist., ser. 9, vol. 10, p. 398, 1922.

This genus of Rock Squirrels is related in essential characters to *Sciurotamias*, but in its gray, black and ochraceous coat with a narrow white lateral line on the flanks, it externally resembles *Menetes*. The claws of the fore feet are elongated, rather blunt. The hind feet have the soles naked except posteriorly, with a long sole-pad, half-way between the heel and the digital pad at the base of the hallux, that is not present in *Sciurotamias*. There are three pairs of mammæ. The skull has "very much the peculiar shape" of that of the latter genus, and is long, low, and subcylindrical, with a long muzzle and short, stout and triangular postorbital processes. The nasals are a trifle pinched-in proximally, and have a somewhat brace-shaped transverse border, about on a level with the ascending processes of the premaxillary. Distally they are somewhat expanded. In the tooth structure *Rupestes* resembles *Sciurotamias*, and is wholly unlike *Menetes*. A further peculiarity as compared with the related genera is the total suppression of the minute anterior pre-molar of the upper jaw, so that the tooth formula is: $i.\frac{1}{1} c.\frac{0}{0} pm.\frac{1}{1} m.\frac{3}{3} = 20$. No trace of this tooth was found in either the permanent or the milk dentition.

The type of the genus, and the only known species, is the following.

283. *Rupestes forresti* Thomas

FORREST'S ROCK SQUIRREL

Rupestes forresti Thomas, Ann. Mag. Nat. Hist., ser. 9, vol. 10, p. 398, 1922.

Type specimen:—An adult female, skin and skull, No. 22.9.1.54, British

Museum, from the Mekong-Yangtze divide, in north latitude $27^{\circ} 20'$, Yunnan, China. Collected June 5, 1921, by George Forrest.

Description.—General color of the upper parts a dark grayish brown, the mixture rather darker than “*chaetura drab*”; the hairs ringed with black and buffy. On each side of the body is a narrow white line from the shoulder to the hip, much as in *Menetes*, but less conspicuous. Flanks broadly washed with ochraceous. Ears buffy brown with darker proëctote. Sides of the head, the throat and sides of the body nearly clear ochraceous, the belly pale ochraceous, its hairs with slaty bases, but from the chin to the chest the hairs are white, forming a prominently contrasted patch. Tail like the back at the base, with a blackish terminal portion.

Measurements.—The following measurements were taken from fresh specimens in the field.

No.	Head and body	Tail	Hind foot (s. u.)	Ear	Locality
22.9.1.52 BM	227	152	50	25	Yunnan
22.9.1.54 BM (type)	224	166	54	27	Yunnan
23.4.1.38 BM	194	130	47	25	Yunnan
23.4.1.39 BM	250	180	50	25	Yunnan

CRANIAL MEASUREMENTS OF *RUPESTES*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
22.9.1.52 BM	—	—	29.7	29.5	22.8	12.8	8.3	8.3	Yunnan
22.9.1.53 BM	53.5	45.3	27.4	—	22.9	13.2	8.8	9.4	Yunnan
22.9.1.54 BM (type)	60.2	50.8	30.4	30.8	24.3	13.3	8.6	8.6	Yunnan
23.4.1.39 BM	55.8	46.5	29.4	29.4	23.5	13.3	8.5	8.7	Yunnan

Occurrence and Habits.—So far as at present known, this squirrel, representing a further-specialized *Sciurotamias*, has a very restricted distribution in northwestern Yunnan. Forrest secured three specimens on scrub-clad cliffs on the Mekong-Yangtze divide, in latitude $27^{\circ} 20'$ north, and later a fourth specimen from the northwestern flank of the Likiang Range, at about 9,000-10,000 feet altitude, and some sixty miles from the original locality. He was not, however, the first to collect the species, for Dr. R. C. Andrews on October 8, 1916, obtained a skin, unfortunately without skull, at Likiang. A third locality in the same general region is Chienchwan, where Mr. Brooke Dolan's West-China Expedition obtained a specimen, now in the Museum of Comparative Zoölogy. This is another of the many peculiar species of the western Chinese highlands that seem to be relicts of an old fauna preserving more or less connecting links between species or genera of wider range.

Specimens examined:—Seven, as follows:

Yunnan: Likiang Range, 1 (A.M.N.H.), 2 (B.M.); Mekong-Yangtze divide, 3 (B.M.); Chienchwan, 1 (M.C.Z.).

Genus **Tamiops** J. A. Allen

STRIPED TREE SQUIRRELS

Tamiops J. A. Allen, Bull. Amer. Mus. Nat. Hist., vol. 22, p. 475, 1906.

Sciurus Milne-Edwards, Recherches pour servir à l'Hist. Nat. des Mammifères, p. 308, 1868-74 (in part).

As the name indicates, the squirrels of this genus resemble the chipmunks (*Tamias* and *Eutamias*) in their pattern of alternating light and dark stripes on the back, but unlike the latter they are arboreal in habits. The ears are slightly tufted with white; the tail is a little shorter than the head and body, and the hind foot has the heel hairy for about the basal fourth, the rest of the sole naked with an elongate, narrow pad on the outer side and a short elliptical one just in advance of it on the inner side. There are the usual five pads under the bases of the digits, that under digit 5 very much smaller than the others. There is a considerable difference between the winter and summer coats, the latter having the three middle dark stripes black or nearly so, while in winter the outer ones are brown and not strongly contrasted with the intervening pale stripes, and even the median stripe is mixed brown and black. The tails are slender and rather thinly furred. The mammæ, as in *Dremomys* and *Sciurotamias*, are six, one pair pectoral, two inguinal. The cranial characters are distinctive. The brain case is full and rounded as in most arboreal squirrels, with a slightly depressed, slender rostrum, flattened just in front of the orbits, and with a noticeably convex forehead. In the unworn upper teeth, the large premolar and first molar show the usual two main cusps in profile view, but only the second molar has an indication of the intermediate cusplet of typical *Sciurus*, while the main transverse ridges in crown view are not continuous but are broken into an outer short ridge and an inner tubercle. "In the lower jaw of *Sciurus* there is on the exterior border of the crown an incipient cusp between the two main cusps of each tooth of the series which is entirely lacking in *Tamiops*; on the inner border the pattern is essentially similar in each" (J. A. Allen, 1906, p. 475).

The tooth formula is as in *Sciurus*, the first upper premolar very small, situated close against the middle of the anterior border of the large second premolar, and succeeded by three molars. There are four lower teeth in the row, of which the first is regarded as a premolar.

Thomas (1915a) has shown that in the characters of the baculum *Tamiops* is related to *Dremomys* in which this bony structure is of the "more specialized" and compound type, with a main shaft, and, attached to its side near the tip,

"a long triangular and pointed blade, recurved backwards towards the hilt of the shaft, which it may equal or exceed in length."

This genus has a wide distribution over the forested area of China from Hopei and western Kansu to Indo-China, Siam, and Tenasserim. It occurs also in Formosa. Owing to a lack of sufficient comparable material, it has not yet been possible to work out in a satisfactory manner all the forms represented. Osgood (1932) has reviewed the group at length with the aid of com-



FIG. 27. Distribution Map.

Tamiops

- | | | |
|-------------------------------------|--------------------------------|---------------------------------|
| 1. <i>T. maclellandi barbei</i> | 3. <i>T. swinhoei swinhoei</i> | 6. <i>T. swinhoei maritimus</i> |
| 2. <i>T. maclellandi inconstans</i> | 4. <i>T. swinhoei clarkei</i> | 7. <i>T. swinhoei hainanus</i> |
| | 5. <i>T. swinhoei vestitus</i> | |

parisons of typical material in the British Museum, but regards his results as largely tentative. It is clear, however, that at least two specific types are recognizable, the one smaller, including the species first described, *Tamiops macclellandi* of Assam, the other larger, typified by *T. swinhoei* of the Szechwan highlands. The wide difference in summer and winter pelages has doubtless led to the description and naming of too many races, and until more specimens can be compared and the seasonal differences well established, it is not possible to present a final estimate of their number.

The genotype is the Hainan race *Tamiops swinhoei hainanus* J. A. Allen.

KEY TO THE CHINESE STRIPED TREE SQUIRRELS OF THE GENUS *Tamiops*

- A. Light lateral stripe clearly continuous across the shoulder with the subocular stripe, belly bright ochraceous; smaller.
 - a. Dark lateral stripes brown in winter pelage. *T. macclellandi inconstans*
 - b. Dark lateral stripes black in winter pelage. *T. macclellandi barbei*
- B. Light lateral stripe not (or rarely) continuous with the subocular stripe, belly whitish or slightly washed with buffy; larger.
 - a. Fore part of shoulders, nape and crown tinged with russet. *T. swinhoei vestitus*
 - b. Fore part of shoulders, nape and crown olivaceous.
 - a'. Outer and inner pale stripes ochraceous buff. *T. swinhoei swinhoei*
 - b'. Outer pale stripe paler than inner, whitish to buffy.
 - a". Larger, hind foot 31-33 mm.
 - 1. Belly nearly pure white. *T. swinhoei clarkei*
 - 2. Belly washed with buff. *T. swinhoei maritimus*
 - b". Smaller, hind foot less than 31 mm. *T. swinhoei hainanus*

284. *Tamiops macclellandi inconstans* Thomas

Tamiops inconstans Thomas, Ann. Mag. Nat. Hist., ser. 9, vol. 5, p. 306, 1920.

Tamiops macclellandi inconstans Osgood, Publ. Field Mus. Nat. Hist., zool. ser., vol. 18, p. 287, 1932.

Type specimen.—An adult male, skin and skull, No. 12.7.25.31, British Museum, from southern Yunnan, probably Mengtsz. Collected January 31, 1910, by H. Orii.

Description.—Smaller, with slenderer tail and shorter hind foot than in the *T. swinhoei* group, and distinguished at all seasons by the obvious continuity of the subocular stripe with the outer light stripe of the back. In winter pelage the three dark stripes of the back are all brown in one of the specimens at hand, but in two others the mid-dorsal stripe is black. Between this stripe and the two other dark stripes, on each side, is an area of light buffy, merging anteriorly with the general olivaceous of the nape and forehead. The outer light stripe is clear buffy, most conspicuous along the shoulders, and widely continuous with the subocular stripe below the ears. The flanks are olive buff like the nape, with a faintly indicated stripe of brown on the outer border of the pale

stripe. A narrow eye-ring is contrastingly ochraceous, and touches the slightly paler stripe that runs forward to the tip of the nose. Entire lower surface, including chin, belly, inside of the hind limbs to the heel and the toes, a bright ochraceous. Ears of the same tint inside, their exterior black with a white tuft. Tail thin and slender, most of the hairs ochraceous at the base, then black, with a white tip on the upper side; ventrally the ochraceous is continuous with that of the belly, and forms a central area, narrowly bordered with black and fringed with white. The summer pelage is unknown.

The skull is smaller than in the *T. swinhoei* group, with proportionate differences, but otherwise is very similar.

Measurements.—Three specimens from the original lot collected by Orii were measured by the collector as follows, except that I have substituted for his "hind-foot" dimension, the length of foot with claws as taken on the dried skin, since Orii's measurement was evidently taken of the naked palm only.

No.	Head and body	Tail	Hind foot	Ear	Locality
13698 MCZ	100	100	26.5	22	"Tonkin"
13699 MCZ	105	95	26.3	15	"Tonkin"
13700 MCZ	100	100	27.0	15	"Tonkin"

CRANIAL MEASUREMENTS OF *TAMIOPS MACCLELLANDI* RACES

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
<i>T. macclellandi inconstans</i>									
12.7.25.31 BM (type)	32.3	27.3	15.5	18.6	15.5	7.5	5.3	5.8	Yunnan
12.7.25.32 BM	32.7	26.8	15.0	17.7	15.8	7.8	5.8	6.0	Yunnan
13699 MCZ	31.2	25.0	14.2	17.2	16.0	7.8	5.5	5.8	Tongking
13700 MCZ	—	—	15.3	18.7	—	7.4	5.7	5.7	Tongking
<i>T. macclellandi barbei</i>									
43251	32.1	26.6	14.5	19.8	15.3	7.6	5.4	5.3	Yunnan
43254	30.3	24.5	13.8	18.9	15.0	7.8	5.4	5.7	Yunnan

Occurrence and Habits.—This subspecies is based on a small series collected in the winter of 1910 in southern Yunnan near Mengtsz and near-by to the southward on the Indo-Chinese border of Tongking. In its winter pelage it is not very different from the race *T. m. laotum* with which it doubtless intergrades. How far it may extend to the north or west is uncertain, but evidently it cannot go far, for it has not been found by various collectors in western Yunnan where its place is taken by the race *T. m. barbei*. It is a low-level species, distinguished from the *T. swinhoei* group by the more delicate hind foot and more stringy tail, with a wash of orange on the belly.

Specimens examined:—Five, including the type and one other from Mengtsh, southern Yunnan (B.M.), and three from the same vicinity, Tongking, Indo-China (M.C.Z.).

285. *Tamiops maccllellandi barbei* (Blyth)

Sciurus barbei Blyth, Journ. Asiatic Soc. Bengal, vol. 16, p. 875, 1847.

Tamiops barbei G. M. Allen, Amer. Mus. Novitates, no. 163, p. 7, 1925.

Type specimens:—According to Robinson and Kloss (1918), the cotypes are two skins and skulls, Nos. 9482 and 9483, in the Indian Museum, Calcutta, from Ye, Tenasserim, India, collected by Rev. J. Barbe.

Description:—This is one of the smaller type of Striped Tree Squirrel, and is tentatively made a subspecies of *T. maccllellandi*. It is remarkable in having the dull winter pelage nearly or quite suppressed so that it wears a bright livery throughout the year, with the five black dorsal stripes clearly defined, and the outer pair of light stripes broad and conspicuously buffy, running from the muzzle, slightly below the eye and base of the ear continuously over the shoulder to the flanks. The median pair of pale stripes is somewhat more ochraceous, and the narrow eye-ring is similar. Elsewhere, the general ground color of the head, back and flanks is olivaceous, tinged with ochraceous and on the flanks slightly grayer. The ears as usual are ochraceous inside, black outside, with a conspicuous white tuft on the posterior edge. Below, the entire surface of the arms, chest, body, and hind legs is ochraceous-orange.

The British Museum has a splendid series of this squirrel taken for the most part in Tenasserim, and therefore typical of the race. These were collected in the months of September, November, and December to May, hence throughout the winter months, yet all are in the bright "summer" pelage with five clear black stripes, and the ochraceous or bright-buffy pale stripes, with the exception, however, of four individuals which show some evidence of the winter type of coat. Of these four, two are from Tenasserim and two from seven miles east of Tamyoo, Burma. In all four, the outer pair of stripes, usually black, are here obsolete, dimly olive brown merging into the ticked olive and ochraceous sides. The two inner black stripes are only slightly blackish, mixed with a good deal of buff and ochraceous-tipped hairs. Even in this condition the outer pale stripe is still broad and clear as in the typical summer condition. Apparently then, the usual type of winter pelage in which the two lateral pairs of stripes become brown and the outer pale stripe becomes narrow and whitish is largely lost, and is indicated in only a few individuals in which the outer black stripes are more or less brownish and partly merge with the surrounding color. The bright summer type of pelage is thus characteristic of both seasons of the year.

Measurements:—The following measurements were taken in the flesh by the collector:

No.	Head and body	Tail	Hind foot	Ear	Locality
43251	112	115	31	15	Yunnan
43254	105	110	29	14	Yunnan

For cranial measurements, see table under *T. m. inconstans*.

Occurrence and Habits:—This race, characterized by its uniformly bright pelage with broad outer stripe continuous over the shoulder throughout the year, extends from Tenasserim to eastern Burma, and just reaches the southwest borders of Yunnan at lower altitudes than the members of the *T. swinhoei* group. Dr. R. C. Andrews secured a series in February, 1917, on the Namting River at about 1,700 feet altitude, and two others in the same month at Mucheng, Salween drainage, as high as 5,000 feet. There is a specimen in the British Museum from Bhamo, just across the boundary of western Yunnan in Burma, taken April 2. All these are quite alike, lacking any pelage characteristic of the winter type with brown stripes. It remains for future collecting to show whether or not this animal intergrades with *T. m. inconstans* to the southeast, and to discover whether the summer pelage of the latter is similar to the permanent style of coloration found in *T. m. barbei*.

Specimens examined:—In addition to the series of thirty-seven skins, studied at the British Museum, from Tenasserim and Bhamo, British India, I have examined the following twelve from Yunnan: Mucheng, Salween divide, 5,000 feet, 2; Namting River at the Burma border, 1,700 feet, 1; Mengting, Burma border, 9.

286. *Tamiops swinhoei swinhoei* (Milne-Edwards)

SWINHOE'S STRIPED TREE SQUIRREL

Sciurus macclellandii var. *swinhoei* Milne-Edwards, Recherches pour servir à l'Hist. Nat. des Mammifères, p. 308, 1868-74.

Tamiops swinhoei Thomas, Proc. Zool. Soc. London, 1911, p. 169. Robinson and Kloss, Records Indian Mus., vol. 15, p. 241, 1918. Osgood, Publ. Field Mus. Nat. Hist., zool. ser., vol. 18, p. 295, 1932.

Tamiops macclellandii russeolus Jacobi, Abh. u. Ber. Mus. f. Tier- u. Völk. Dresden, vol. 16, no. 1, p. 11, 1922. *Tamiops macclellandii swinhoei* G. M. Allen, Amer. Mus. Novitates, no. 163, p. 5, 1925.

Type specimen:—No type is specified by Milne-Edwards in describing this squirrel, but he implies that there were several specimens, obtained by Père Armand David in the Muping district, central Szechwan, China, in the summer season. These probably came from near the base of Hongchantin at about 6,500 feet, where David stayed for about a year.

Description:—An adult male in summer pelage (September 20) has the top

of the head from the nose to the nape, the fore and hind legs and the flanks a dark olivaceous, due to a mixture of fine, all-black hairs with the more abundant hairs having extensive pale-ochraceous to buffy tips. The center of the back is marked by five dark stripes, of which the median and the first lateral are broad and deep black, shading posteriorly into olive brown. The second (outer) pair of lateral stripes is shorter, the upper border black but the lower edge mixed with brownish, and grading into the color of the flanks. The area between the median stripe and the first outer stripe on each side is olive buff, paler than the nape, while the outer pair of light stripes is bright ochraceous. These stripes are broad and conspicuous, and are almost or quite continuous at the sides of the neck with a buffy stripe from below the ear and the eye to the tip of the muzzle on each side. There is a narrow pale ochraceous-buff eye-ring, and the rim of the ear is of the same tint. Externally the ear is thickly clothed with dense black hairs which, just below the tip, become clear white terminally, making a conspicuous and contrasting white tuft. The fore feet are ochraceous buff, the hind feet slightly more mixed with black. The tail is narrow and rather thinly haired, colored essentially like the flanks both above and below, the individual hairs having a basal ring of black, then one of deep ochraceous, another of black, and a short ochraceous tip. The last forms a short external fringe, except at the tip of the tail which is black. Underneath, the chin and throat are whitish, washed with pale buffy, while elsewhere the grayish of the flanks passes into the paler gray of the belly, with a wash of pale buffy over the tips of the hairs.

In winter pelage (February 10, Mucheng) the color of the head and flanks is paler, distinctly grayish, the two dorsal light stripes nearly the same as the nape, but paler, the two pairs of outer dark stripes brownish and not sharply contrasted, quite lacking any trace of black, while the outer pale stripe on each side is less intense ochraceous or nearly like the inner one, and, in contrast to the summer condition, is not continuous at the sides of the fore shoulder with the buffy stripe from the tip of the nose below the eye to the base of the ear. The entire ventral surface is grayish at the bases of the hairs, which then, especially in the median area, are tipped with pale buff.

Measurements:—The following measurements were taken in the field from the fresh specimens:

No.	Head and body	Tail	Hind foot	Ear	Locality
43261	115	106	32	13	Yunnan
43262	120	110	34	14	Yunnan
43263	120	110	35	14	Yunnan
43264	120	105	34	14	Yunnan
7586 MCZ	141	107	33	—	Szechwan
11.2.1.88 BM	123	110	34	17	Szechwan

CRANIAL MEASUREMENTS OF *TAMIOPS SWINHOEI*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
<i>T. swinhoei swinhoei</i>									
7586 MCZ	38.5	30.4	17.4	21.0	17.2	9.5	7.2	6.8	Szechwan
43262	35.5	29.0	16.6	21.0	17.2	9.0	6.0	5.9	Yunnan
II.2.I.88 BM	38.2	31.5	18.0	22.2	17.4	9.3	6.9	6.7	Szechwan
<i>T. swinhoei vestitus</i>									
45324	35.6	29.6	16.9	21.4	16.6	8.5	6.0	6.0	Hopei
56840	35.5	30.0	17.3	21.5	16.9	8.9	6.2	6.1	Hopei
56842	35.8	30.4	17.1	22.0	16.7	8.9	6.0	6.0	Hopei
<i>T. swinhoei maritimus</i>									
84570	37.4	31.2	17.8	23.4	16.2	9.1	6.5	6.3	Fukien
84571	37.3	31.5	17.8	22.0	16.3	8.4	6.4	6.2	Fukien
84572	36.5	30.6	16.6	22.3	17.0	8.8	6.6	6.5	Fukien
84575	37.0	30.7	17.5	22.0	16.2	8.7	6.5	6.0	Fukien
84576	37.1	31.0	17.5	23.0	17.0	9.0	6.5	6.6	Fukien
84589	38.3	32.0	18.5	22.0	16.3	8.8	6.5	6.5	Fukien
84591	36.2	30.1	17.5	21.5	16.2	9.0	6.6	6.5	Fukien
84592	36.8	31.0	17.7	21.2	16.4	8.8	6.6	6.3	Fukien
84593	36.2	30.0	17.0	21.5	16.0	8.7	6.8	6.8	Fukien
<i>T. swinhoei hainanus</i>									
57963	32.9	27.0	15.0	20.1	16.8	7.9	5.8	5.5	Hainan
57996	33.4	27.3	15.7	20.3	17.3	8.1	5.8	5.8	Hainan
57965	32.4	27.1	15.5	20.2	15.6	8.3	6.0	5.6	Hainan
58011	32.1	26.9	15.0	19.2	16.0	7.9	6.0	6.0	Hainan
58020	31.0	25.2	14.8	18.6	15.5	8.0	6.1	6.1	Hainan
58026	32.6	—	15.5	18.9	14.7	7.9	5.9	5.8	Hainan
<i>T. swinhoei clarkei</i>									
43268	35.2	28.5	16.3	20.8	16.4	8.3	5.9	5.7	Yunnan
27452 MCZ	—	29.1	16.5	—	16.0	8.5	6.0	5.6	Yunnan
20.I.16.6 BM	—	—	17.1	23.3	—	9.2	7.3	6.8	Yunnan
(type of <i>T. clarkei</i>)									
20.I.16.4 BM	—	29.5	16.5	21.2	17.0	8.8	6.3	6.0	Yunnan
(type of <i>T. m. forresti</i>)									
22.9.I.61 BM	34.5	28.0	15.8	20.3	17.3	8.5	5.9	6.0	Yunnan
22.9.I.62 BM	35.5	30.2	16.8	—	16.3	8.8	6.2	6.1	Yunnan

Nomenclature.—The many described forms of this genus offer a puzzling problem when it comes to considering their mutual interrelationships. Robinson and Kloss (1918), in their review of the oriental squirrels, regarded *Tamioops swinhoei* as a species distinct from the first-described *T. macclellandi*, to which

all the others are referred as subspecies. No doubt several of the races described are either identical with others or very closely related. In some cases, too, separate names have been given to what now, with additional information in the matter, are seen to be but seasonal differences. Osgood (1932), the latest writer to review the genus as a whole, believes that two species groups may be differentiated, the more southern and smaller represented by *T. macclellandi* of Assam, the more northern and slightly larger typified by *T. swinhoei*. Nevertheless, the differences are small when sufficient series are compared, and no doubt the status of the various forms requires much more material for a final solution. In the following pages I have followed Thomas, Robinson and Kloss, and Osgood in regarding the *T. swinhoei* series as distinct specifically from the *T. macclellandi* forms. Osgood would go farther and consider the former as possibly containing three species, *T. swinhoei*, *T. maritimus*, and *T. monticolus*; he admits, however, that the two latter are described from seasonally different phases, and with a re-study of the matter, I would regard the two names as referring to but a single race. The character that he points out, that skulls of *T. monticolus* "have the anterior zygoma root somewhat compressed and sloping whereas those of *maritimus* have it abruptly bowed," does not appear to be important nor, apparently, does it hold in the series I have examined. Jacobi (1922) has described as subspecies *russeolus* summer skins from Tsalila, near Atuntze, northern Yunnan, but it does not appear that this is different from *T. s. swinhoei*, of which he had no specimens for comparison. I am therefore provisionally including it in the synonymy of that species.

Occurrence and Habits:—The typical race is characteristic of the saturate mountain-forest area of central Szechwan. The original series came from the Muping district, near the base of Hongchantin at 6,500 feet altitude, where Père David, the collector, stayed for about a year. Thomas (1911d, p. 169) has recorded a specimen taken by Anderson at Omei Shan, slightly to the southward, while to the west, a handsome male, with a skull above the average in length, was taken at Tachiao (Tachow). The last is in summer pelage, but, allowing for the dulling of the black stripes and restriction of the outer bright stripes in the shoulder region, a series in winter pelage (February) from Mucheng on the Salween drainage is so similar as to leave no room for doubt that it represents the same race. Typical *T. s. swinhoei* in summer pelage has the two light stripes on each side a bright ochraceous, the median stripes only a little duller than the outer, but in winter the median ones are more mixed with grayish, so that they are a paler buff and more nearly resemble the color of the flanks. Practically nothing is recorded of the habits, but all the group are tree-living; Bonhote, writing of a Malay race, says that they are in part insectivorous. Jordan and Rothschild (1911) have described a new species of

flea, *Ceratophyllus euteles*, from a specimen of this species taken near Tatsienlu, Szechwan (Hsikang).

Among the series in the British Museum is one of Père David's original specimens. Another shows an interesting condition of moult; it is labeled merely "Setchuan," May 29. The fore part of the body to the shoulders is acquiring the summer pelage, while the posterior half still retains the winter coat, with a line of demarcation between. The hinder part of the body has the mid-dorsal line narrow and black, but the two lateral dark stripes are dull brown mixed with ochraceous and black and hardly distinct, while the intermediate areas are mixed buffy olive, even the outer pale stripe not very much lighter. On the fore part of the body, the bright ochraceous-buff outer stripe is coming in for about an inch on the shoulders, and for the same distance the two pairs of lateral black stripes are distinct, replacing the dull brown ones of winter, though a few rusty hairs still remain in them. David's specimen and a second taken August 15 at Omei Shan are in nearly full summer pelage with the black stripes all well defined and the outer pale stripe of a clear ochraceous buff. Another in the British Museum, collected by Dejean in 1896 at Tatsienlu, is in full winter pelage, but presents a ruddy phase, with the dark side-stripes and the pale interspaces and rump suffused with rusty. Possibly a condition such as this was the basis for Jacobi's *T. m. russeolus*.

Specimens examined:—Fourteen, as follows:

Szechwan: Muping, 1 (B.M.); Tatsienlu, 1 (B.M.); Heakeetun, 2 (B.M.); Yangliupa, 1 (B.M.); Omei Shan, 1 (B.M.); Tachiao, 1 (M.C.Z.); Tsungshi (Ngoloshi), 2 (A.N.S.P.); near Hokow, 1 (A.N.S.P.).

Yunnan: Mucheng, Salween drainage, 4.

287. *Tamiops swinhoei vestitus* Miller

Tamiops vestitus Miller, Proc. Biol. Soc. Washington, vol. 28, p. 115, 1915.

Sciurus maccllelandi Jentink, Notes Leyden Mus., vol. 5, p. 139, 1883.

Tamias maccllelandi Buechner, Bull. Acad. Imp. Sci. St. Pétersbourg, vol. 34 (new ser., vol. 2), p. 109 (Mélanges Biol., vol. 13, p. 155), 1892 (in part).

Tamiops maccllelandi vestitus Jacobi, Abh. u. Ber. Mus. f. Tier- u. Völkerk., Dresden, vol. 16, no. 1, p. 11, 1922.

Type specimen:—A skin and skull, No. 199561, U. S. National Museum, from Hsinlungshan, on a hunting reserve sixty-five miles northeast of Peiping, Hopei, China. Collected February 15, 1915, by Arthur de Carle Sowerby.

Description:—In summer pelage (topotype, August 1) the area between the eye and the ear, the backs of the limbs, and the flanks are mixed buffy gray. Of the five dark stripes on the back, the median one is deepest black, commencing on the nape; the next outer pair begin on the shoulders, are wide and black, and run like the median stripe nearly to the base of the tail; these lateral black stripes are bordered medially by a grayish white stripe from the lower

neck, and externally by a clearer, sharply defined white stripe from the shoulder nearly to the base of the tail, and are rather indistinctly continuous with the cheek stripe. The fore part of the body from the fore shoulders to the crown and muzzle is more or less tinged with russet, varying somewhat individually, and with wear. There is a narrow pale-buffy eye-ring, and a prominent white stripe from the muzzle, running just below the eye to the base of the ear and traceable across the shoulder to the lateral body stripe. The backs of the feet are buffy gray, very slightly mixed with darker. The tail above has the long hairs gray at the base, then a ring of ochraceous, followed by one of black and a buffy tip, the black rings combining to form a distinct border and the buffy tips a fringe. On its lower side the entire central area of the tail is clearer ochraceous or ochraceous buff with the black border and short buffy fringe. The under surface of the body is nearly white with a faint wash of buffy, and with gray bases to the hairs.

In winter pelage the dark dorsal stripes become much less black and sharp. The median stripe is partly mixed with russet, and the bordering light stripe is grayish. The inner pair of dark stripes instead of being deep black are olive brown, while the outer pair of dark stripes, even in summer very indistinct and faintly marked, are practically obsolete, becoming brownish gray and merging imperceptibly with the buffy gray of the flanks.

In cranial characters there are no important differences from typical *T. s. swinhoei*.

Measurements:—The following measurements were taken from the fresh specimens by the collector:

No.	Head and body	Tail	Hind foot	Ear	Locality
45307	145	90	32	14	Hopei
45311	150	90	33	14	Hopei
45312	140	85	32	14	Hopei
45315	145	84	34	15	Hopei
45317	146	80	35	15	Hopei
56840	142	90	34	15	Hopei
56843	142	88	35	16	Hopei
56847	140	93	32	16	Hopei

For cranial measurements, see table under *Tamias swinhoei swinhoei*.

Occurrence and Habits:—This race of northern China is much grayer in appearance, with grayer flanks, than typical *T. s. swinhoei*, and the outer pale stripe is white instead of bright ochraceous. There is also in the summer coat a conspicuous russet wash over the crown, nape and shoulders. This squirrel was found by Sowerby to be almost entirely arboreal in habits, living in holes in oak trees, and leading an active life, taking "enormous" leaps from one tree to another. Apparently it has a very wide distribution across northern China,

paralleling that of *Sciurotamias davidianus*, for, in addition to the fine series collected by the Central Asiatic Expeditions in the Eastern Tombs region of Hopei, there are specimens in the Museum of Comparative Zoölogy from western Kansu, Na Tebbuland, that are nearly indistinguishable. These are in summer pelage and average a trifle more buffy underneath, and possibly minutely more russet across the shoulders, as compared with Hopei specimens, but the differences are unimportant, and come within the range of variation. Apparently no specimens have ever been found in the intermediate regions of southern Shansi and Shensi, yet one may assume that they may occur in suitable situations. Berezovski collected the species in the winter of 1886 about Ssigu, and Potanin brought back another from the country between there and Upin, southern Kansu. The series of skins obtained by Dr. Joseph F. Rock along the border of southwestern Kansu in Na Tebbuland probably represents nearly the extent of the range in that direction.

Jentink (1883) records two in the Leiden Museum from Tingchow (probably Hopei, some distance south of Peiping) received from Consul Swinhoe.

Specimens examined:—In all, twenty-seven, as follows:

Hopei: Eastern Tombs, 23.

Kansu: Upper Tebbuland, banks of Chilingapu, 3 (M.C.Z.); Na Tebbuland, Wantsangku, 1 (M.C.Z.).

288. *Tamiops swinhoei clarkei* Thomas

CLARKE'S STRIPED TREE SQUIRREL

Tamiops clarkei Thomas, Ann. Mag. Nat. Hist., ser. 9, vol. 5, p. 304, 1920.

Tamiops maritimus forresti Thomas, *ibid.*, p. 305.

Tamiops swinhoei clarkei Osgood, Publ. Field Mus. Nat. Hist., zool. ser., vol. 18, p. 286, 1932.

Type specimen:—An adult male, skin and skull, No. 20.1.16.6, British Museum, from northern Yunnan, in the Yangtze valley, at about 27° 20' north latitude, and 101° east longitude, China. Collected September, 1918, by George Forrest.

Description:—The type, in summer pelage, is described as having the coloration brightly contrasted, the ground color of the crown, nape and fore back pale buffy olivaceous, paler than Ridgway's "buffy olive"; under surface white, not yellowish, the hairs of the chin white to their roots, those of the belly with slaty bases. There are the usual five deep-black stripes on the back, sharply defined, with paler, olivaceous-buffy areas between them. The outer light stripes are broad and white, not continuous with the subocular stripe, which itself is broad and white. Hands and feet grayish buffy.

A specimen in winter coat (November 18), apparently this race, has the crown, nape, fore back and the pale inner dorsal stripes a light buffy gray with

a greenish tinge, the flanks grayer, the feet pale ochraceous. The median dark stripe is much mixed with olive brown, while the next lateral dark stripes and the outer dark stripes are broad and of an olive-brown color. The outer light stripe is whitish with a more or less buffy tint. There is almost no buffy tint on the ventral side, but the hairs are gray-based with whitish tips and the faintest wash of buffy over the chest and inguinal region. The tail is mixed black and olivaceous buff above and clearer ochraceous buff below in the central area.

Measurements:—The dimensions of four specimens from near the type locality, as taken by the collector, are as follows:

No.	Head and body	Tail	Hind foot	Ear	Locality
43265	120	105	33	14	Yunnan
43266	125	108	32	13	Yunnan
43267	122	—	31	17	Yunnan
43268	125	95	33	15	Yunnan

For skull measurements, see table under *Tamiodops swinhoei swinhoei*.

The skull is apparently closely similar to that of typical *T. s. swinhoei*, except that it is very slightly smaller, with smaller audital bullæ, a difference that Osgood is inclined to consider of almost specific value, on the basis of available data.

Nomenclature:—There seems to be much puzzling variation in this group as to size, color shades, and the degree to which the outer pale line is continuous across the shoulders with the subocular stripe. It was apparently in part on the basis of the uninterrupted stripe that Thomas named *T. maritimus forresti* from the Likiang Range, not very far distant from the type station of *T. s. clarkei*, but Osgood, after examining the types, writes (1932, p. 295) that "actual differences between them, however, are not too great to be bridged" and is inclined to consider both as subspecies of *T. swinhoei*, rather than distinct species. I have carefully studied the series in the British Museum as well as the series secured by Dr. Andrews, and am convinced that the two are the same, and that the difficulty comes in not realizing that the type of *T. m. forresti* still retains, even in July, most of the winter pelage. The key to the situation is perhaps afforded by a very small nest young taken in September in the Yangtze valley. It is just getting its first pelage, the pattern of which is exactly that of the adult in summer coat, with five very clear and sharply marked black stripes on the upper side. The area between the median and first outer black stripes is yellowish olive, while the outer pale stripe is broad, white, and sharply defined. Obviously an animal born late in the summer, if it must first carry the summer type of pelage, will be delayed in the acquisition of its full winter coat. The varying condition of the winter coat in its black or

brown stripes will thus depend on the age of the animal in its first winter, whether it was born early or late in the summer. Thus, while the type of *T. s. clarkei*, taken in September, is in full summer pelage, the type of *T. m. forresti*, captured in July at an altitude of 11,000 feet on the Likiang Range, is still largely in the long winter coat and shows an intermediate condition in which the lateral dark stripes are still somewhat mixed with brown, and the area between the two upper dark stripes is still olive greenish. The lateral pale stripe is tinged with buff. A youngish specimen (Likiang, August 22) is already becoming brown in its side stripes (perhaps born early in the season); two other individuals from the same place, November 14, 15, are in complete winter coat with the outer pale line narrow and buffy, the lateral dark stripes brown, and the median blackish stripe narrow, while elsewhere the greenish or olive-buff of the winter condition is fully evident. A third specimen, taken December 5 at 11,000 feet on the Likiang Range, is probably a late-summer young, for it still retains the distinctly black stripes of that pelage, although they are filling in with brown and the white side stripe is buffy. The moult in young and vigorous animals is gradual, new hair growing in and replacing the old without noticeable contrasts of different areas, but in old individuals it progresses less gradually, passing as a wave from muzzle to tail and, as in the case of one of the examples of typical *T. s. swinhoei* previously noted, showing the new coat on the fore parts of the body, while the old coat is still intact posterior to the line of advance.

Occurrence and Habits.:—The race of this squirrel found in southern Szechwan and the Likiang region is readily distinguished by its paler olive-green back, the more whitish subocular stripe, and the nearly white instead of buff tint of the ventral side. At the shoulder the white line of the sides of the body is distinctly interrupted in November specimens, but in some cases may be dimly traced though not sharply outlined. With wear the tips of the hairs disappear and the median dorsal stripe becomes more sharply black in the winter pelage, the greenish tint becomes browner, the shoulders grayer. As mentioned by Osgood, intergradation with *T. s. swinhoei* to the north is indicated. He records *T. s. clarkei* from Wushi, southwest of Tatsienlu, and from Kulu, upper Yalung River in western Szechwan. A specimen collected by Dr. J. F. Rock at Taomungchung, southwest of Lutien, Yunnan, is in the Museum of Comparative Zoölogy, and there are in the American Museum of Natural History specimens collected by Dr. R. C. Andrews and Edmund Heller on the Likiang Range at 10,000 feet altitude, and forty miles north of Likiang near the summit of Peishui. Thomas (1923, p. 661) records four from the same range and altitude, as well as a pair from the Mekong valley, 5,000 feet, at 27° 30' north latitude, and in a previous paper (1922b), six others, identified as *T. m. forresti*, from 10,000-11,000 feet on the Likiang Range.

Owing to age differences and other causes, the precise date when seasonal change of pelage may be expected is variable. Summer coat is present, however, in specimens as early as June 11 and as late as October.

Specimens examined:—Twenty-five, namely:

Yunnan: Likiang, 10,000 feet, 5 (A.M.N.H.); 12, including type of *T. m. forresti* (B.M.); Taomungchung, southwest of Lutien, 10,000 feet, 1 (M.C.Z.); Mekong-Yangtze divide, 9,000-10,000 feet, 2 (B.M.); Yangtze valley, 27° 20' north, 8,000 feet, 3, including type of *T. s. clarkei* (B.M.); Mekong valley, 5,000 feet, 2 (B.M.).

289. *Tamiops swinhoei maritimus* (Bonhote)

Sciurus maccllelandi maritimus Bonhote, Ann. Mag. Nat. Hist., ser. 7, vol. 5, p. 51, 1900.

Sciurus maccllelandii swinhoei Thomas, Proc. Zool. Soc. London, 1898, p. 771 (in part).

Sciurus maccllelandi monticolus Bonhote, Ann. Mag. Nat. Hist., ser. 7, vol. 5, p. 52, 1900.

Tamiops maccllelandi maritimus and *T. m. monticolus* Robinson and Kloss, Records Indian Mus., vol. 15, p. 240, 1918.

Tamiops maritimus and *T. monticolus* Osgood, Publ. Field Mus. Nat. Hist., zool. ser., vol. 18, p. 297, 1932.

Type specimen:—The type of *S. maccllelandi maritimus* is a skin and skull from Foochow, Fukien, China, No. 94.9.1.11, British Museum, collected in April, 1893, by C. B. Rickett.

Description:—The type is in winter pelage and agrees with specimens from Futsing, Fukien, taken at the same season. The top of the head is dull olivaceous, tinged with ochraceous buff; the neck and shoulders, the two dorsal pale stripes and the sides of the body below the outermost stripe, the hips and limbs are a grayer tint of olivaceous, slightly buffy in the upper arm region. The median stripe commences at the shoulders and is traceable nearly to the root of the tail, black in the center and more or less minutely mixed with brown toward the borders, which are thus not sharply defined. This narrow black stripe is succeeded by two pale stripes, one on each side, grayish buff like the fore back, then a broad rusty-brown stripe of practically the same length, beyond which is a rather sharply marked band of about half the width of the brown one, of a pale-buffy white, at the sides of the neck becoming lost in a small buffy-gray area, but indistinctly continuing forward to the well-marked subocular stripe, which is white from below the ear to the eye, but tinged with ochraceous in front of the eye. There is a narrow ring of the same around the eye, and the rims of the ears as well as their inner surface are tinged also with ochraceous. The subocular stripe is sharply outlined by darker blackish brown above and below. The backs of the ears are black with a terminal white tuft. On the lower surface of the body and limbs the hairs are everywhere gray-based, tipped with buffy white, which is strongest in the mid-ventral region. The tail consists of longer hairs having two black rings separated by a broad ring of ochraceous and tipped with white except at the end.

In summer pelage (a June 18 specimen from Chungan) the median dorsal stripe is clear black, unmixed with brown, and sharply marked; the two lateral dark stripes are broad and deep black instead of brown, while the pale stripe included between them and the median stripe is brighter buffy in contrast to the grayish of winter; the outer pale stripe is broad and sharp, of a buffy white and is bounded on its outer edge by a short ill-defined stripe of black mixed with brown. The outer white stripe ends at the shoulders in a small rust-colored patch that forms a distinct break between it and the cheek stripe. The general ground color of the forehead and fore back is more buffy gray to rusty gray than in winter, and the two pale dorsal stripes are even more rusty gray in contrast to their duller tone in winter.

In the skull the audital bullæ are very little smaller than in *T. s. vestitus*.

Measurements:—The following measurements were taken by the collector in the field:

No.	Head and body	Tail	Hind foot	Ear	Locality
84571	125	110	29	16	Fukien
84572	124	95	29	15	Fukien
84573	120	100	29	15	Fukien
84574	130	95	28	15	Fukien
84576	130	102	27	15	Fukien
84578	131	95	29	—	Fukien
84583	130	102	30	15	Fukien

Probably the hind foot measurement is without the claw.

For cranial measurements, see table under *Tamias s. swinhoi*.

Nomenclature:—Although Bonhote (1900) believed that there was a lowland coast race and an inland mountain race of "*Sciurus macclellandi*," to which he gave the names *maritimus* and *monticolus* respectively, there seems to be little doubt, as Osgood (1932) has pointed out, that these are but seasonal differences. At all events, a large series from Futsing on the coast near Foochow, which I had previously called *S. m. maritimus*, is not noticeably different in size from a series in summer pelage from the type locality of *S. m. monticolus*. Osgood also writes that "there is no convincing evidence of color distinctions between *maritimus* and *monticolus*. Likewise there appears to be no difference in size." This being the case, it would seem that the two are indistinguishable, and indeed one would hardly expect that so slight a change of altitude as 2,500 feet would serve to develop an upland and a lowland form. Osgood further points out that there seems to be a slight difference in the few comparable skulls he had, in the shape of the anterior root of the zygoma, bowed out or "squared" in *S. m. maritimus* and more sloping in *S. m. monticolus*, so that on this basis he regards it possible that the two are really

distinct species, notwithstanding that they are externally alike. For the present, however, I think it best to call them one until further evidence of distinctness can be brought forth.

Occurrence and Habits:—This is apparently a common squirrel in the wooded country of Fukien. The series in the American Museum of Natural History contains a large number from Futsing, Yenping, Yuki, and Chunganhsien. Those from the last locality, in the northwest corner of Fukien, are practically topotypes of *S. m. monticolus*. Outside this province, Mell (1922) says that it is found in the south of Kwangtung and is common in the forests of the northern part of that area, as in Dingwu, Lofau, Mahutze Shan, and other mountain forests. Swinhoe (1870c) had recorded this type of squirrel from Kwangtung in 1870. Shih (1930, 1930b) has collected squirrels of this genus on the southwestern border of Hunan, which he believes to be larger and "grayer in belly" than a series from Kwangsi. These latter he thinks may represent two distinct subspecies, but for lack of comparable material he is unable to identify them certainly. It seems likely, however, since his collections were made in March, and in April to June, that the differences were seasonal. Styan (De Winton and Styan, 1899, p. 578) found what is undoubtedly this same squirrel in southern Anhwei at Tsingte (Chinteh), but was unable to distinguish it from "*Sciurus swinhoei*." I have since compared this series in the British Museum with typical *T. s. maritimus*, and believe them to be identical. They were taken in April and are still in winter pelage. There is little recorded as to this squirrel. The breeding season apparently begins in spring, for Mr. Clifford H. Pope obtained three young of very small size, evidently nestlings, on April 28, 1926, in the mountains at Chunganhsien.

The type and other Foochow specimens in the British Museum series were all taken in late April and are in worn and faded winter coat, which may have misled Bonhote, for those he named *S. macclellandi monticolus*, from Chungfengling, are December specimens in freshly assumed winter fur.

The range extends westward to Hupeh, from the southern part of which the British Museum has a specimen taken at Changyang.

Specimens examined:—In all, one hundred and one, including the types of *S. m. maritimus* and *S. m. monticolus*, as follows:

Fukien: Chunganhsien, 21; Futsing, 11; Kucheng, 1; Yenping, 18; Yuki, 7; northwestern part, 2; Foochow, 5 (B.M.); Pucheng, 2 (B.M.); Kuatun, 8 (B.M.); Chungfengling, 8 (B.M.); Kienyang, 1 (B.M.); Tingchow, 2 (B.M.).

Anhwei: Chinteh, 10 (B.M.).

Kiangsi: eastern, 1 (B.M.).

Chekiang: Ningpo, 1 skull (B.M.); no exact locality, 1 (B.M.).

Hupeh: Changyang, 1 (B.M.).

Kwangtung: Chiong Lok, one hundred miles west of Swatow, 1 (B.M.).

290. *Tamiodps swinhoei hainanus* J. A. Allen

Tamiodps maclellandi hainanus J. A. Allen, Bull. Amer. Mus. Nat. Hist., vol. 22, p. 476, 1906.

Sciurus m'clellandi Swinhoe, Proc. Zool. Soc. London, 1870, p. 232.

Tamiodps maclellandi riudoni J. A. Allen, Bull. Amer. Mus. Nat. Hist., vol. 22, p. 477, 1906.

Tamiodps maritimus hainanus Osgood, Publ. Field Mus. Nat. Hist., zool. ser., vol. 18, p. 289, 1932.

Type specimen.—An adult female, skin and skull, No. 26664, American Museum of Natural History, from Leimuimon in the mountains of central Hainan, China. Collected December 31, 1902.

Description.—In winter pelage the Hainan race of this squirrel is very similar indeed to *T. swinhoei maritimus*, the only noticeable color difference being that the outer pale stripe is buffy instead of white, although occasional individuals of the latter may have it slightly tinged with buffy as well. In such cases the only difference to be found is in the size of the hind foot which is slightly smaller, and in the skull which is likewise less in size. Possibly also, the lateral pale stripe is not so long as in the mainland race, not reaching quite to the base of the tail. All the specimens in the large series studied are in the dull pelage, and there appears to be no description published of the summer coat. No doubt, however, it is, as in other races, brighter, with the three black lines on the back showing clearly.

Measurements.—It is obvious from the following field measurements, as well as from the comparison of the skins themselves, that the hind foot in the island race is somewhat smaller than in the Fukien race. Otherwise the general bodily proportions are much the same.

No.	Head and body	Tail	Hind foot	Ear	Locality
57989	115	80	25	11	Hainan
57991	116	100	25	11	Hainan
57992	128	110	28	12	Hainan
57993	125	103	29	11	Hainan
57994	119	104	27	10	Hainan
57995	125	103	27	12	Hainan
57996	120	93	26	12	Hainan
57997	112	99	27	11	Hainan
57998	116	103	26	12	Hainan
57999	125	108	29	13	Hainan

The skull is smaller throughout than in *T. s. maritimus* from Fukien, as is shown clearly in the table of skull measurements given under *T. swinhoei swinhoei*.

Nomenclature.—Misled by a reddish discoloration of the specimens taken by a Chinese collector at Riudon, Hainan, Dr. J. A. Allen decided to describe them as *T. maclellandi riudoni*, a distinct subspecies from *T. maclellandi hainanus*, which he named in the same paper. Osgood (1932) concludes, and

with good reason, that these are synonymous. He would also provisionally regard *T. s. maritimus* as a distinct species with *T. m. hainanus* as a smaller southern race, for he shows that the fine series in winter pelage secured by the Kelley-Roosevelts and Delacour Expeditions in Tongking are not apparently to be distinguished from the squirrel of Hainan which is the type of the genus. While final conclusions are doubtless not yet possible, I prefer to think of those of the "*swinhoei* group" as local races of a single species, with analogous cases in so many other instances, while those of the typical *macclellandi* group may be thought of as similarly representing a more southern species. The two seem to occur together in some parts of Tongking, as Osgood has described.

Occurrence and Habits:—This pretty squirrel is common in the forest jungle in some parts of Hainan. Mr. Clifford H. Pope, who secured a large series there, writes that he found it "all about Nodoa in the jungle patches, in the hedges, in the prickly bamboo patches, in large bushes, and in isolated groups of trees. Some lived in the banyan trees in the Mission compound. It is easily alarmed, but quick to forget. When once startled, however, its speed in escaping is remarkable,—it is off and vanishes like a flash. A favorite place is a mass of vines covering and draped over a dead tree. When running through the trees, it follows the trunk and larger branches, making great leaps from one to another. If slightly alarmed it may make a sound like a cluck or short chirrup. It seems to go singly or in pairs. I have never seen more than two near together unless there were five or six on a tree feeding. I have seen them at all times of the day but the very early morning seems to be their time of greatest activity. I have never seen one on the ground." Swinhoe, writing in 1870, says that it is found in the interior forests, especially where *Areca* and cocoanut occur, and that it runs with great agility on the ground and up trees but descends awkwardly.

That this same squirrel occurs in Tongking has been lately brought out by Osgood (1932), who records a series from that region, so no doubt it is to be found also on the more immediately adjacent mainland. Possibly the record of Mell as to the presence of this type of squirrel in Kwangtung may refer to the present race rather than to *T. s. maritimus*. Furthermore, as Osgood states, it is still uncertain whether or not, when summer series are available, the mainland animal will be found to differ slightly.

Specimens examined:—In all, eighty-six, namely:

Hainan: Nodoa, 72; Namfong, 13; no locality, 1 (B.M.).

Genus **Ratufa** Gray

GIANT SQUIRRELS

Ratufa Gray, Ann. Mag. Nat. Hist., ser. 3, vol. 20, p. 273, 1867 (as a subgenus). Thomas, Proc. Zool. Soc. London, 1897, p. 993 (genus).

Apart from their very large size, the Giant Squirrels are distinguished by the heavy skull, with its short, broad rostrum, the distance from the back to the front of the nasals being about half the zygomatic width. The extremity of the nasals is distinctly turned downward, and forms a point medially. The postorbital processes are very large and triangular. In profile the brain case is not much higher than the rather deep muzzle, and shows a slight depression above the orbit, with scarcely any convexity behind it as in many tree squirrels. There is no small third premolar in the upper jaw, but the fourth is well developed, though with a smaller crown area than the succeeding molars. The two main transverse enamel ridges are obvious in side view of the upper anterior molars, the last having but one, the anterior. The surface of the crowns shows under the lens a slightly rugose appearance. The tooth formula is: $i. \frac{1}{1} c. \frac{0}{0} pm. \frac{1}{1} m. \frac{3}{3} = 20$.

According to Thomas (1915a), the baculum is remarkable among oriental squirrels in being simple, rather than of the compound type, and in this respect it also resembles that of *Funambulus*. There are three pairs of mammæ, one pectoral and two inguinal. The type of the genus is *Sciurus* (= *Ratufa*) *indicus* Erxleben, of India.

291. *Ratufa gigantea gigantea* (McClelland)

GIANT SQUIRREL

Sciurus giganteus McClelland, in Horsfield, Proc. Zool. Soc. London, 1839, p. 150.

Ratufa gigantea gigantea Robinson and Kloss, Records Indian Mus., vol. 15, p. 192, 1918.

Type specimen.—The type was sent by McClelland to the Museum of the East India Company in London, but according to Robinson and Kloss seems to be no longer in existence. It was collected in Assam.

Description.—In this species there are well-developed bushy ear tufts. The entire upper surface of the head and body, the outside of the limbs and the upper surface of the feet, as well as the tail, are "either wholly black or reddish-brown, without any trace of white." An elongated black spot is present below the eye from the side of the muzzle, and the eye is encircled with black. There are usually two black spots on the chin. The under parts and the inside of the limbs are "rather bright yellow" (Anderson).

According to Anderson the broad terminal portion of the nasals is rather characteristic of this species, and the shortness of the muzzle in addition tends to give the skull a broad short rostrum.

Measurements.—None.

Occurrence and Habits.—The Giant Squirrels are essentially natives of the tropical forests, and hence barely reach the very southernmost corners of China. The first to record the present species from the country was J. Anderson (1879),

who secured specimens at Tengyueh (Momein) in southwestern Yunnan in 1868, at an altitude of about 6,000 feet. Two of these are still in the Indian Museum. Dr. Roy C. Andrews also met with this squirrel on the Namting River, Burma border, 1,700 feet, and secured native skins at Watien in extreme southwestern Yunnan. Here he found them "very shy and as they climbed about in the highest trees they were by no means easy to see or shoot." Probably this squirrel occurs elsewhere along the southernmost border of Yunnan, for several were obtained on the Tongking border of Indo-China by the Kelley-Roosevelts Expedition (Osgood, 1932), where Yunnan makes its southernmost extension.

Specimens examined.—Three in all, namely:

Yunnan: Namting River, Burma border, 1; Watien, 2.

292. *Ratufa gigantea hainana* J. A. Allen

HAINAN GIANT SQUIRREL

Ratufa gigantea hainana J. A. Allen, Bull. Amer. Mus. Nat. Hist., vol. 22, p. 472, 1906.

Type specimen.—An adult male, skin and skull, No. 26638, American Museum of Natural History, from Cheteriang, island of Hainan, China.

Description.—This race is similar to the typical form, but the belly is darker, and the size possibly somewhat smaller. The type is described as having the whole upper parts, outside of limbs, and the tail a uniform deep black with the ventral surface of body and limbs rusty yellow. The bases of the hairs over the chest and belly are brownish black showing more or less at the surface over the central part of the abdomen. The broad black cheek stripes and the two small black spots on the chin are present as in the typical race. The ears are tufted (J. A. Allen, 1906, p. 472).

Measurements.—No measurements of fresh specimens are available. The hind foot of the type specimen measured (dry) 85 mm. with claws.

CRANIAL MEASUREMENTS OF *RATUFA GIGANTEA HAINANA*

No.	Greatest length	Basal length	Palatal length	Zygomantic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
26638 (type)	74.0	—	—	46.0	—	—	—	—	Hainan
10.4.25.8 BM	74.6	63.8	33.0	46.5	34.9	20.4	14.3	15.4	Hainan
10.4.25.9 BM	—	—	33.9	49.5	37.1	20.2	14.6	15.0	Hainan

Occurrence and Habits.—The Hainan Giant Squirrel was not known to Swinhoe when he wrote his list of the mammals of the island in 1870. It is apparently rare and local in its distribution. At all events, the type was the first specimen to be brought to the notice of naturalists in 1906. Dr. J. A.

Allen, in a supplement to his paper, records in 1909 four additional specimens from Mt. Wuchih, Hainan, that agreed with the type in every respect. These were collected in 1905, and the British Museum has two from the same place. The only other record is of one secured at Namfong, March 14, 1923, by Mr. Clifford H. Pope, who writes that in spite of many inducements offered to the native hunters, they were unable to secure but this one. The native name among the Miaos means "tree dog." It is said to be extremely agile and to live in high forest. It is possible that it is represented on the neighboring mainland.

Specimens examined:—Three, as follows:

Hainan: Namfong, 1; Mt. Wuchih, 2 (B.M.).

Genus **Eutamias** Trouessart

CHIPMUNKS

Eutamias Trouessart, Bull. Soc. d'Études Sci. d'Angers, vol. 10, p. 86, 1880.

Sciurus Pallas, Nov. Spec. Quad. e Glir. Ord., p. 378, 1778 (not of Linnaeus).

Tamias Swinhoe, Proc. Zool. Soc. London, 1870, p. 444 (and other earlier writers; not *Tamias* Illiger, 1811).

These are small and rather shaggy-haired squirrels, with five well-marked black lines on the back, the outer pair enclosing a white line, and having thus a general resemblance in color pattern to *Tamiops* but without the latter's tufted ears. There are capacious cheek pouches and four pairs of mammæ. The skull is characteristic of a burrowing mammal in being relatively flattened without the convex brain case of the tree-living species. The rostrum is relatively longer than in *Tamiops*, and tapers gradually to the tip, instead of being rather abruptly narrowed at the base. Additional characters are given by A. H. Howell (North Amer. Fauna, no. 52, p. 26, 1929) as follows: the zygomatic plate much more nearly in the plane of the palate than in tree squirrels; "notch in posterior edge of zygomatic plate of maxillary opposite middle or hinder part of pm⁴; . . . upper incisors with numerous longitudinal striations, often well defined; . . . lower molars with a small cusp between the protoconid and hypoconid, not reaching the outer border of the tooth row; last molar relatively long, often slightly longer than m₂." The upper tooth rows diverge conspicuously, and in the lower row the teeth increase in size from the small premolar to the last molar. There is a minute upper premolar, pm³, in addition to the large molariform pm⁴, so that the tooth formula is: $i.1 \frac{1}{2} c.0 pm.2 \frac{2}{3} m.3 = 22$. A small point of difference from *Sciurus* and many tree squirrels is the circular instead of slit-like antorbital foramen for the passage of a branch of the fifth nerve. The baculum, according to A. H. Howell (1929), is, in the Old World species, "quite different from that of the American," being "much slenderer and more simple," about 5 mm. long, tapering gradually from base to tip, with "the distal portion upturned in an even curve and slightly flattened, but without ridges."

The type species of the genus is the Asiatic *Sciurus striatus* α *asiaticus* Gmelin. It had previously been supposed that Gmelin's name was the earliest applicable to a form of the Asiatic Chipmunk, but Chaworth-Musters (1937) has lately demonstrated that a still older name is that of Laxmann, *Sciurus sibiricus*, the type locality of which is Barnaul, in Tomsk, western Siberia. The following eastern races will stand therefore as subspecies of *Eutamias sibiricus*.

KEY TO THE CHINESE AND MONGOLIAN RACES OF *Eutamias*

- A. Rump not strongly tinged with rufous.
 - a. Flanks and rump pale ochraceous. *E. sibiricus asiaticus*
 - b. Flanks and rump dull buffy olive. *E. sibiricus albogularis*
- B. Rump strongly tinged with rufous; nape and shoulders gray.
 - a. Colors brighter. *E. sibiricus senescens*
 - b. Colors paler, especially of flanks. *E. sibiricus ordinalis*

293. *Eutamias sibiricus asiaticus* (Gmelin)

PALLAS'S CHIPMUNK

Sciurus striatus, α . *asiaticus* Gmelin, Linnaeus's Syst. Nat., ed. 13, vol. 1, pt. 1, p. 150, 1788.

Eutamias asiaticus J. A. Allen, Bull. Amer. Mus. Nat. Hist., vol. 19, p. 137, 1903.

Type specimen.:—The name *asiaticus* is based on Pallas's description of this squirrel in "Nov. Species Quad. e Glir. Ord.," pp. 378-384, 1778, the locality being Siberia,—in omni "boreali ad fluvios europeos Dwina et Kama usque." In view of this very inclusive area for the original locality, Dr. J. A. Allen has selected as type locality Gichiga, west coast of the Okhotsk Sea, Siberia, and takes as the type of his description, No. 18474, American Museum of Natural History, collected August 12, 1900. This was apparently overlooked by Chaworth-Musters who, in 1937, regarded the type locality as Atchinsk, Siberia.

Description.:—General coloring paler than in the other races examined. Top of head from snout to between the ears, a short line between the eye and the ear, and a second line from the base of the whiskers to the base of the ear, a mixture of black and ochraceous-rufous hairs. Eyelids whitish, this color extending back in slightly duller tint, above and below the dark stripe joining eye and ear, to form two short cheek stripes. Five sharply marked black lines on the back, of which the median one is longest, extending from the crown quite to the basal part of the tail; the inner pair of lateral black stripes are shorter, running from the shoulder nearly to the base of the tail; the outer pair shorter, well marked and as black as the others. Nape and shoulders gray, with a slight wash of buffy. The inner pale stripes are gray to whitish anteriorly but become edged with buffy and pale ochraceous in their posterior half. The outer pale stripes are clearer white and shorter, although in some specimens they may be traced faintly from the foreshoulder to the lower side

of the ear, where they join the subocular stripe. Rims of the ears whitish, their proëctote mixed black and rufous. Sides of the cheeks below the dark line, the fore and hind limbs and feet, as well as the flanks, pale ochraceous buff. The tail has the bases of the hairs above of the same tint, then an equally long black ring and a white tip, producing a mixed effect. On the ventral side of the tail, the median area is clear ochraceous, bordered by black, and the hairs are tipped with white. The lower side of the body from chin to anus and the inner sides of the legs are white, with scarcely any tint of buffy, but the hair of the chest and belly is light gray at the base.

The skull is of the usual somewhat flattened type in the ground squirrels.

Measurements.—The following field measurements are those of the ten largest specimens in a series from near Urga, Mongolia.

No.	Head and body	Tail	Hind foot	Ear	Locality
45814	145	93	36	17	Mongolia
45816	150	105	37	18	Mongolia
45817	143	104	35	15	Mongolia
45819	140	110	36	15	Mongolia
45826	145	100	36	17	Mongolia
57396	145	105	36	16	Mongolia
57399	141	108	35	17	Mongolia
57401	151	—	35	17	Mongolia
57402	146	—	36	19	Mongolia
57403	140	—	37	16	Mongolia

CRANIAL MEASUREMENTS OF *EUTAMIAS*

No.	Greatest length	Basal length	Palatal length	Zygomastic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
<i>E. sibiricus asiaticus</i>									
45813	36.8	31.5	18.6	19.8	17.4	9.3	6.5	6.2	Mongolia
45814	37.5	32.3	19.3	21.4	17.6	9.7	6.0	5.8	Mongolia
45819	36.0	30.1	17.7	18.7	16.6	8.9	6.5	6.0	Mongolia
45824	38.2	33.3	19.6	21.7	17.5	9.6	6.2	6.2	Mongolia
57403	37.5	32.5	18.5	22.2	17.0	9.5	6.3	6.3	Mongolia
14399 MCZ	38.8	32.8	19.7	21.2	16.3	9.8	6.5	6.3	Siberia
25965 MCZ	38.0	32.6	19.0	21.8	17.3	9.8	6.0	5.8	Siberia
<i>E. sibiricus senescens</i>									
56848	39.6	34.4	19.8	22.0	17.6	9.9	6.5	6.5	Hopei
20590 MCZ	41.0	34.5	20.5	22.4	18.0	10.3	5.9	6.4	Jehol
9.I.I.41 BM	39.5	34.0	20.1	22.1	18.3	10.1	6.9	6.5	Shansi
9.I.I.42 BM	41.3	34.5	20.8	22.9	18.6	10.4	6.8	6.7	Shansi
(type of <i>E. a. intercessor</i>)									
9.I.I.43 BM	39.5	33.8	19.9	22.4	18.6	10.0	6.5	6.5	Shansi
9.I.I.44 BM	39.7	33.3	19.5	22.4	19.2	10.3	6.8	6.9	Shansi
9.I.I.54 BM	38.6	33.4	19.7	22.3	18.6	10.3	6.8	6.6	Shansi
19.I2.22.8 BM	39.5	34.1	20.2	22.6	18.3	10.2	6.5	6.3	Hopei

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
<i>E. sibiricus albogularis</i>									
23274 MCZ	—	—	20.6	21.6	17.0	9.9	6.9	6.9	Kansu
240744 USNM (type of <i>E. a. umbrosus</i>)	42.0	—	—	—	—	—	—	—	Kansu
<i>E. sibiricus ordinalis</i>									
9.I.I.31 BM	41.1	35.0	20.3	22.5	18.7	10.3	6.8	6.8	Shensi
9.I.I.32 BM	39.4	33.1	19.5	22.7	18.6	10.1	6.6	6.5	Shensi
9.I.I.33 BM	41.0	34.7	20.2	23.0	19.3	10.6	6.9	6.7	Shensi
9.I.I.34 BM	41.0	34.9	20.7	23.5	19.6	10.5	6.9	6.8	Shensi
9.I.I.35 BM	39.8	34.0	19.7	22.2	19.2	10.2	6.5	6.5	Shensi
9.I.I.36 BM(type)	39.8	32.6	19.3	22.4	19.1	10.0	6.5	6.7	Shensi
9.I.I.37 BM	40.5	34.7	20.1	22.9	19.1	10.8	6.4	6.5	Shensi
9.I.I.39 BM	41.5	35.5	20.9	22.1	19.4	10.6	6.6	6.7	Shansi
9.I.I.40 BM	40.3	34.7	20.7	22.9	18.8	10.8	6.8	6.7	Shansi

Occurrence and Habits.—This form of the Striped Chipmunk is characterized by its five well-marked black lines enclosing four white stripes of which the central pair is nearly as clear as the lateral pair, and the general hue of the rump, sides, and hind quarters is a distinctly buffy olive without trace of rufous tints. Specimens from Gichiga and Lake Baikal, Siberia, are indistinguishable from those collected by the American Museum Asiatic Expeditions in Mongolia. Its range extends from the northeastern part of Siberia to the Altai and southward across the northern border of Mongolia, following the tree growth to the northern edge of the Gobi. No doubt its food is largely the seeds of larch cones, in certain seasons at least, and its distribution is in large part coincident with that of the larch in northern Mongolia. Buxton, who collected a series at Gichiga, northeastern Siberia, for the American Museum, secured a number of specimens as they were feeding on the green cones in the tops of these trees. On approaching Urga, Mongolia, from the south, the American Museum Asiatic Expeditions met with this species not far to the northeast at about fifteen miles from the city. A series was also secured at Sainnoin Khan farther to the west, where, as near Urga, the larch forest reaches its southern limit. Dr. Roy C. Andrews describes this place as a north-south valley with grass-covered hills absolutely treeless on the south side, but with a strip of larch forest some ten miles long on a small east-west tributary valley. Northward the larch forest is more or less continuous, with little underbrush but a thick carpet of moss and a certain amount of spruce, pine, birch and oak. Specimens secured are all in summer pelage, and were taken between the dates June 9 and September 12.

Specimens examined.—In all, thirty-eight, as follows:

Mongolia: fifteen miles northeast of Urga, 10; forty-five miles northeast of Urga, 19;
Sainnoin Khan, 9.

294. *Eutamias sibiricus senescens* Miller

GRAY-MANTLED CHIPMUNK

Eutamias senescens Miller, Proc. Acad. Nat. Sci. Philadelphia, 1898, p. 349.

Tamias striatus Swinhoe, Proc. Zool. Soc. London, 1870, p. 444.

Tamias pallasi Buechner, Bull. Acad. Imp. Sci. St. Pétersbourg, vol. 34 (new ser., vol. 2), p. 157, 1892 (in part).

Tamias (Eutamias) asiaticus Rhoads, Proc. Acad. Nat. Sci. Philadelphia, 1898, p. 122.

Eutamias asiaticus senescens Thomas, Proc. Zool. Soc. London, for 1908, p. 968, 1909.

Eutamias asiaticus intercessor Thomas, *ibid.*, p. 969. Ningwufu, Shansi.

Type specimen.—A skin and skull, No. 83395, U. S. National Museum, from low, barren hills fifteen miles west of Peiping, Hopei, China.

Description.—A very slightly larger race than *E. s. asiaticus* distinguished by the gray shoulders and rust-colored rump. A specimen from the Eastern Tombs, Hopei, July 31, has the top of the head grizzled rusty; the cheeks show two white lines, one from the tip of the nose to a point above and behind the eye, and a second cut off from the first by a short rusty-ochraceous bar from eye to ear; a longer rusty-ochraceous stripe runs from the base of the vibrissæ to a point just back of the ear. The shoulders and sides of the neck are nearly clear gray, the flanks, upper arm, and the outer side of the hind limbs ochraceous. The dark dorsal stripes are black, very slightly mixed with rusty, and this same tint is strongly marked over the lower back from the extreme base of the tail to the posterior part of the inner dark stripes and the paler area between them, as well as to the hinder half of the outer dark stripes, although the white outer stripe is clear. The tail is buffy at the bases of the hairs, then black-bordered and white-tipped; on its lower side the central area appears clear buffy ochraceous. The throat and chest are nearly clear white, but elsewhere on the lower side there is a faint buffy wash over the white tips of the hairs.

Except for the slightly larger size, the skull does not differ from that of the typical race.

Measurements.—The following field measurements are available.

No.	Head and body	Tail	Hind foot	Ear	Locality
45309	165	115	36	15	Hopei
45310	155	110	37	14	Hopei
56848	155	120	40	18	Hopei
56849	155	123	38	19	Hopei
45374	155	120	40	13	Shansi
57393	153	132	35	18	Shansi
57394	152	129	35	20	Shansi

For cranial measurements, see table under *Eutamias sibiricus asiaticus*.

Nomenclature:—The examination of a considerable series of these chipmunks from eastern China leads to the conclusion that *E. senescens* is really not a distinct species from *E. asiaticus*, as Jacobi (1922) and I (1925) had both previously supposed, but only a well-marked race of *E. sibiricus*, with a gray mantle and rusty rump. Thomas (1909) named as a second subspecies, *E. a. intercessor*, the chipmunk of central Shansi (type from Ningwufu), but, although some individuals appear a little paler than others from Hopei, the range of variation is practically the same and there seems to be no good ground for considering the animal distinct. Probably the paler individuals from the edge of the Ordos Desert are a local race as named by Thomas.

Occurrence and Habits:—The Gray-mantled Chipmunk has a wide range in the semi-arid regions of northeastern China. Avoiding the sandy wastes of the Gobi, it follows the sparsely wooded country around the eastern end of Hopei, doubtless intergrading with typical *E. s. asiaticus* somewhere in northern Hopei, for Rhoads (1898) and Miller (1898) describe two specimens from Tungchingtzu and Sianlangkou, south and southeast of Dolon Nor in the foothills of the Khingan Range, that the latter author regards as of this race. About Peiping it is found in suitable places, as at Tungling (Eastern Tombs), whence Dr. R. C. Andrews secured specimens, and in the hills to the west of the city, whence came the type and a series secured later for the British Museum by M. P. Anderson at Montouko. Probably it has been driven out from some of the areas to the south by excessive cultivation and deforestation, for there appear to be no records of it from Shantung, though doubtless it should be expected there. In Shansi it is common and widely distributed, according to Sowerby, who obtained specimens from the country about Taiyuanfu, as well as others from fifty miles northwest of Sianfu, Shensi. Specimens from Ningwufu, Shansi, were regarded by Thomas as slightly different in the buffy tint and described as a race, *E. a. intercessor*, but the differences are inconstant, and individuals from northern Shansi are not separable from others taken in Hopei. Dr. F. R. Wulsin collected a series for the Museum of Comparative Zoölogy in northern Shansi, near the borders of the Ordos Desert, that likewise are indistinguishable. The localities are: Yirgo and Pashuiko (northwest of Kweihwacheng) and the central part of the province south of Taiyuanfu. Farther southwest it probably grades into the race *E. s. albugularis* of the Tsingling Mountains and Kansu.

As with the chipmunks of America, the Asiatic species is inactive in its burrows in winter and lays up a store of food for its occasional use during this period. Sowerby writes (1914) that "when the wild apricots are on, these little creatures climb the trees for the fruit, and can easily be caught with cunningly set snares, made by the natives out of horse hair." Its usual haunts seem to be rocky, bush-grown areas, and its food is doubtless somewhat differ-

ent from that of the typical race of the northern larch forests. Buechner (1892) says that at Utaishan, Shansi, it was found in steep, boulder-strewn valleys and in rock piles in fields.

I have seen no specimens in winter pelage, but Miller (1898) describes the two from the foothills of the Khingan Range, above mentioned, as in worn winter pelage as late as June 18. This seemed to differ very little from the summer coat, except in being slightly paler.

Specimens examined:—In all, forty-three, as follows:

Shansi: Kweihwacheng, 1; Maitaichao (forty-three miles east of Paotow), 4; Pashuiko, 7; sixty to seventy miles southwest of Taiyuanfu, 2 (M.C.Z.); Yirgo, 1 (M.C.Z.); no exact locality, 1; Ningwufu and vicinity, 12, including type of *E. a. intercessor* (B.M.).
 Hopei: Eastern Tombs, 4, 2 (B.M.); Montouko, fifteen miles west of Peiping, 5 (B.M.); Nankow Pass, northwest of Peiping, 2 (B.M.); Wawayü Mountains, northeastern Hopei, 1 (B.M.); thirty kilometers north of Balihandien, 1 (M.C.Z.).

295. *Eutamias sibiricus ordinalis* Thomas

ORDOS CHIPMUNK

Eutamias asiaticus ordinalis Thomas, Abstr. Proc. Zool. Soc. London, December 15, 1908, p. 44; Proc. Zool. Soc. London, for 1908, p. 968, 1909.

Type specimen:—An adult female, skin and skull, No. 9.1.1.36, British Museum, from Yulinfu, northern Shensi, China. Collected May 1, 1908, by M. P. Anderson and A. de C. Sowerby.

Description:—This is described as a paler race confined to a very limited area along the border of the Ordos Desert, though not in the desert itself. The color is slightly paler throughout, the crown paler, approaching pinkish buff, the shoulders and nape with almost no gray in them, "scarcely more grey-grizzled than the cream-buff cheeks and sides; rump more or less ochraceous buff, markedly brighter than in *senescens*, where it is 'raw umber'; dark dorsal stripes lightened in intensity by their hairs being largely tipped with ochraceous."

It is true that the original series from Yulinfu, when laid out in a row, appears paler than *E. s. senescens* of the British Museum series, the shoulders slightly less gray, and the yellowish tint of the rump lacking the rusty of the latter. Yet since these are in late winter coat, the difference, slight enough at best, may really be merely seasonal. None in summer pelage is available from the region of the type locality.

Measurements:—The collector's measurements of the topotypical series follow:

No.	Head and body	Tail	Hind foot	Ear	Locality
9.I.I.31 BM	146	127	38	19.0	Shensi
9.I.I.32 BM	140	134	38	18.5	Shensi
9.I.I.33 BM	145	129	38	19.0	Shensi
9.I.I.35 BM	140	123	39	19.0	Shensi
9.I.I.36 BM (type)	139	(125)	39	19.5	Shensi
9.I.I.37 BM	145	(110)	38	18.0	Shensi
9.I.I.40 BM	150	118	37	18.0	Shensi
9.I.I.30 BM	144	135	39	20.5	Shensi

For cranial measurements, see table under *Eutamias sibiricus asiaticus*.

Occurrence and Habits.—It seems to me very doubtful if this is really a distinct race. The specimens on which it was based were collected in late April and early May, so that they were still in the winter coat which may in part account for their slightly paler tint. The country where they occur is semi-desert, but probably not more so than that in which *E. s. senescens* lives in northern Shansi. However, until more evidence can be brought forward, it may stand as a poorly marked subspecies of the arid portion of northern Shensi.

Anderson writes that these chipmunks live in low bushes, not climbing trees. "Not until the latter part of April, about the time we reached Yu-lin-fu, did the weather become warm enough to attract the Chipmunks from their holes. They frequent the sides of the loess gullies mostly, and are usually fairly common where found at all . . . A large proportion of Chipmunks, wherever we found them, had their tails broken short."

Thomas refers to this race three specimens that were collected in the mountains twelve miles northwest of Kolanchow, Shansi, a place hardly twenty-five miles from the type locality of his *E. a. intercessor*, so that it seems evident that the distinction, if warranted, must be a very fine one, for other examples taken at no great distance to the north are clearly *E. s. senescens*. These specimens, which I saw at the British Museum, seem very doubtfully distinct from the latter.

Specimens examined.—I have studied the original series at the British Museum, eleven in all, namely:

Shensi: Yulinfu, 8, including the type (B.M.).

Shansi: twelve miles north of Kolanchow, 3 (B.M.).

296. *Eutamias sibiricus albogularis* J. A. Allen

OLIVE-BACKED CHIPMUNK

Eutamias albogularis J. A. Allen, Bull. Amer. Mus. Nat. Hist., vol. 26, p. 429, 1909.

Eutamias asiaticus albogularis Jacobi, Abh. u. Ber. Mus. f. Tier- u. Völkerk., Dresden, vol. 16, no. 1, p. 13, 1922.

Eutamias asiaticus umbrosus A. B. Howell, Journ. Washington Acad. Sci., vol. 17, p. 80, 1927. One hundred and forty miles south of Lanchowfu, Kansu.

Type specimen.—An adult male, skin and skull, No. 27565, American

Museum of Natural History, from Taipai Shan ("Tai-pa-shiang"), Shensi, China. Collected July 13, 1905, by Alan Owston.

Description.—This is a well-marked race, characterized by its darker coloring. The sides from the mouth to the dark facial stripe, the sides of the neck and upper arm, the flanks, hips and rump are a duller and darker shade than in any of the other races. The posterior half of the inner pair of light dorsal stripes is duller than in *E. s. senescens*, with in some specimens a slight rusty tinge, varying to bright ochraceous, while the shoulders lack the gray mantle, and the outer white stripe is nearly or quite continuous across the shoulder with the whitish subocular stripe. Crown dark, a mixture of black, rufous and ochraceous. The five black stripes of the back are clearly marked, the outer pair slightly mixed with rusty. Chin and throat white to the bases of the hairs, but on the chest and belly the fur is slaty at base, and the whitish tips are more or less washed with buff.

Measurements.—The size is practically as in the other races. Howell gives for the type of his *E. a. umbrosus* from Kansu: head and body, 155 mm.; tail, 115; hind foot, 38; ear, 17. Other measurements are not available.

Complete skulls are at present unavailable, but a few measurements are given under *E. sibiricus asiaticus*.

Occurrence and Habits.—The chipmunk along the more southern parts of its range in the Tsingling Mountains (Taipai Shan) and on the north slopes of the Min Shan in western and southern Kansu is a darker animal without the pale gray mantle and bright rusty rump of the chipmunk of the drier country to the northeast, as might be expected from the moister conditions under which it lives. The type series came from Taipai Shan, southern Shensi, and, thanks to the kindness of Dr. H. E. Anthony of the American Museum, I have been able to compare them with specimens from Choni in southern Kansu, not far from the type locality of *E. a. umbrosus* A. B. Howell. There can be no doubt that all represent the same form, and the distinctive characters pointed out by the latter author apply equally to the specimens from Shensi. A skin in the Museum of Comparative Zoölogy, collected by Dr. J. F. Rock in Na Tebbuland on the western border of Kansu in September, seems to represent the freshly assumed winter pelage. It is slightly darker across the shoulders, a mixture of blackish and ochraceous giving a dull olive tint, with no trace of gray; the area between the stripes on the nape is dark olive, and the crown and the lateral dark markings of the head are duller in tone than in *senescens*. It is provisionally referred to this race, though possibly intermediate toward *E. s. altaicus*. The most southern locality known for this race is slightly north of Sungpan in northwestern Szechwan, whence a series was secured by Mr. Brooke Dolan and H. Weigold at Merge and Hoanglungtze in 1931. In their dull

olive rump and lack of clear gray across the shoulders, these specimens agree very well with those from the northern slopes of the Min Shan.

Specimens examined.—Eighteen, as follows:

Shensi: Taipai Shan, Tsingling Mountains, 6 (type and topotypes).

Kansu: Choni, 3 (M.C.Z.); Na Tebbuland, 1 (M.C.Z.); forty-six miles southeast of Taochow, 1 (B.M.).

Szechwan: Merge and vicinity, 4 (A.N.S.P.); Hoanglungtze, 3 (A.N.S.P.).

Genus *Citellus* Oken

SUSLIKS

Citellus Oken, Lehrbuch d. Naturgesch., vol. 3, pt. 2, p. 824, 1816.

Spermophilus F. Cuvier, Dents des Mammifères, p. 160, 1825.

The spermophiles or susliks have a wide distribution in the temperate parts of the Old and New Worlds from the plains of eastern Europe, across northern Asia and western North America to the Mississippi valley. They are strictly ground-living, making burrows in loose soil, and seem to be favored by an arid climate, for they spend the winter in hibernation. They may be thought of as squirrels modified for a terrestrial life through the shortening of their tails, reduction of the external ears to a low ridge, the development of stout claws for burrowing and powerful chest- and limb-muscles for the same use. The skulls show corresponding modification in the rather flattened profile, the general stoutness and heaviness of bone, the strong rostrum and narrow anterior portion of the zygomatic arch, giving a somewhat triangular form to the whole, as a burrowing adaptation. The teeth are relatively larger than in most tree squirrels, the tooth rows slightly divergent, the first upper premolar large with about one-third the crown area of the second. The maxillary teeth have the same general structure as in typical squirrels, *Sciurus*, but the transverse ridges in the upper series are somewhat higher and more prominent, and in the lower series there is a prominent lengthwise ridge joining the two infolds of enamel near the outer side of each tooth. The tooth formula is: $i. \frac{1}{1} c. \frac{0}{0} pm. \frac{2}{1} m. \frac{3}{3} = 22$. Recently Obolenski (1927) has briefly reviewed the palæarctic susliks and distinguishes three subgenera: *Colobotis*, with the soles of the hind feet naked, the tail a third of the length of head and body or less; typical *Citellus*, in which the soles are hairy, the tail from a third to a fifth of the head-and-body length; and *Urocitellus*, a new subgenus for *Citellus eversmanni*, in which the tail is from a third to a half the length of head and body, and the skull more elongate. It must be admitted, however, that the groups are not very sharply defined. All three are represented in North China and Mongolia.

There are five pairs of mammæ, two of which are pectoral, three abdominal. Large cheek pouches are present as in *Eutamias*.

Pocock (1923) has figured the baculum in *C. d. mongolicus*, and showed that in this genus it differs remarkably from that of the tree squirrels in that it consists of a taper-pointed shaft at the tip of which on the dorsal side there is a widely expanded plate-like hood, roughly semicircular in outline, with a finely denticulate edge. The shaft itself is not straight, but has in side view a somewhat bow-shape, with the convexity in the middle third, and facing ventrally.

KEY TO THE CHINESE AND MONGOLIAN SPECIES OF *Citellus*

- A. Center of the soles of the hind feet hairy.
- a. Tail longer, about half the length of head and body; least distance between orbits exceeding the maxillary tooth row. . . . Subgenus *Urocitellus*
C. eversmanni jacutensis
 - b. Tail shorter, less than half the length of head and body; least distance between orbits equaling the maxillary tooth row. . . . Subgenus *Citellus*
 1. Dorsal coloring pale. *C. d. dauricus*
(northeastern Mongolia)
 2. Dorsal coloring distinctly ruddy in summer. *C. d. mongolicus*
(Hopei, Shantung, eastern Shansi)
 3. Dorsal coloring distinctly pinkish buff. *C. d. alaschanicus*
(western Shansi to eastern Kansu)
 4. Dorsal coloring sandy, without pink or ruddy tints. *C. d. obscurus*
(western Kansu and western Mongolia)
- B. Center of the soles of the hind feet naked.
- a. Tail short, the central part rusty, fringed with white but quite without black. Subgenus *Colobotis*
C. pallidicauda

297. *Citellus eversmanni jacutensis* (Brandt)

EVERSMANN'S GROUND SQUIRREL

Spermophilus jacutensis Brandt, Bull. Acad. Imp. Sci. St. Pétersbourg, cl. phys.-math., vol. 2, p. 378, 1844.

Spermophilus eversmanni Buechner, Bull. Acad. Imp. Sci. St. Pétersbourg, vol. 34 (new ser., vol. 2), p. 157, 1892.

Citellus eversmanni Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 9, p. 393, 1912.

Citellus eversmanni jacutensis G. M. Allen, Amer. Mus. Novitates, no. 163, p. 4, 1925.

Citellus eversmanni stramineus Obolenski, Compt. Rend. Acad. Sci. URSS, 1927A, p. 192. Northwestern Mongolia.

Citellus jacutensis Obolenski, *ibid.*, p. 193.

Type specimen.—Pallas described the differences between the Ground Squirrel of the Yakutsk district, Siberia, and the typical *C. eversmanni* of western Siberia, and Brandt later named the former on the basis of his description. Possibly some of Pallas's original material is still in existence in Leningrad.

Description.—In summer pelage the crown and nape are bright buffy gray, clearer clay color at the anterior end of the rostrum, and mixed buffy and black over the top of the head. The back from the nape to the base of the tail is a mixture of black and gray in which the gray subterminal bands of the otherwise

black hairs tend to concentrate or overlap, forming small and ill-defined spots. The entire middle area of the back is thus given a speckled appearance. A ring of buffy white around the eye. Sides of the head below the eyes, and including the ears, sides of the neck and body, the fore and hind legs and feet clear "ochraceous." Lips and chin clear white; the throat and belly ochraceous, the bases of the hairs dark slaty brown. Inner sides of the limbs whitish, and the mammae marked by a small tuft of white hair. The tail on the upper side is like the back at its extreme base, but distally the longer hairs are tawny ochraceous for their basal two-thirds, then black, tipped with white, so that above, the tail is mainly grizzled black and white, with a white fringe terminally, while below, the central area is clear tawny ochraceous fringed with white and having a conspicuous subterminal black band in the distal third.

The winter pelage is very much paler, the bright ochraceous of the sides and belly giving place to white with a faintly buffy tinge, while the mid-dorsal area is also paler, with short slaty or blackish bases to the hairs, succeeded by a long white or a buffy band and with a minute black tip. The pale buffy bands give the general tone to the coloring, but the pure white bands tend to concentrate into irregular spots, as in the summer coat. The tail is practically as in summer.

The skull is not especially modified, beyond the usual strengthening of the zygomatic arches, the prominent postorbital processes, the generally flattened appearance.

Measurements:—The following field measurements were made by the collector:

No.	Head and body	Tail	Hind foot	Ear	Locality
57419	200	100	45	10	Mongolia
45763	245	110	50	11	Mongolia

CRANIAL MEASUREMENTS OF *CITELLUS EVERSMANNI JACUTENSIS*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper tooth row	Lower tooth row	Locality
45745	49.1	43.3	27.3	29.0 ca.	22.6	13.9	11.0	9.5	Mongolia
57441	46.0	—	25.6	29.8	—	14.0	11.0	10.1	Mongolia
45763	52.6	46.6	30.5	—	24.7	14.9	11.3	10.6	Mongolia
23963 MCZ	55.7	49.1	31.5	35.3	26.1	16.5	12.2	11.7	Siberia

Nomenclature:—Obolenski has proposed to consider *C. jacutensis* as a species distinct from *C. evermanni*, and to distinguish as *C. evermanni stramineus* the animal of northwestern Mongolia, on the ground of its lighter and grayer crown, and paler and more yellow coloring than the typical race. It seems very doubtful if there is really enough difference to allow of a race here,

for animals in corresponding pelage are quite identical from eastern Mongolia and Yakutsk, whence I have had practically topotypes for comparison. It is possible, however, that the former may average slightly smaller.

Occurrence and Habits:—This large species is characteristic of the northern edge of Mongolia, extending from arctic Siberia southward to the limit of the thinly wooded and grass country bordering the desert itself. It does not, however, extend around the eastern end of the desert, but ranges north of it to the Amur region. In traversing the route from Kalgan to Urga, Dr. Andrews first met with this species some twenty miles southwest of Urga. At an equal distance to the northeast of that city, and especially at a locality some forty-five miles northeast, he secured a large series. After leaving Urga, where he had camped in the Tola valley, Dr. Andrews continued his journey westward sixty miles near the river, but saw no more of these spermophiles; some forty miles farther to the southwest, however, a few more were encountered in shallow ravines into the sides of which they burrowed. At a camp forty miles southwest of Tsetsen Wang, there were again a few, but they were evidently rare. "About ten miles from Sain Noin Khan," Dr. Andrews writes, "we reached the center of their abundance and there we saw them in hundreds all over the plains. They were not particularly wary and it was easy to shoot them. It evidently has a rather wide east and west distribution, going right up the open valley to the summit of the arctic divide, and I suspect, follows over to the other side in the grassy valleys between the patches of forest." He adds further, that "all the *Citellus* appear to be in very narrow zones north and south and this is one of the most interesting distributional problems. There will be a wide area of country in which none occur and suddenly a new species will show up for no apparent reason in the terrain. It may be connected with the flora and geology."

Thomas (1912a, p. 393) has recorded specimens from the mountains west of Achit, northwestern Mongolia, as well as from the upper Yenesei, Minusinsk, and the Tannu Ola. Buechner (1892) mentions one secured by Potanin at Changai (?Mongolia).

In specimens taken at Sainnoin Khan in the first week of June, the new summer coat is just coming in as a bright ochraceous patch on the muzzle and about the ear region; in others taken June 10 and 11, the new coat is coming in on the shoulders as well. In a large series taken in mid-July near Urga, the summer coat is fully assumed.

Specimens examined:—In all, one hundred and seven, as follows:

Mongolia: twenty miles northeast of Urga, 2; forty-five miles northeast of Urga, 58; thirty miles southwest of Urga, 1; Sainnoin Khan, 33; Tsetsen Wang and vicinity, 10; Hurumtu, 1.

Siberia: Yakutsk Province: Namskoje, 2 (M.C.Z.).

298. *Citellus dauricus dauricus* (Brandt)

Spermophilus dauricus Brandt, Bull. Acad. Imp. Sci. St. Pétersbourg, cl. phys.-math., vol. 2, p. 379, 1844.

Citellus dauricus Trouessart, Cat. Mamm. Viv. Foss., p. 340, 1904.

Type specimen.—This name was based on Pallas's account of a specimen taken near Tarei Nor in northern Mongolia, but it is probably no longer in existence, unless it is among those still preserved in the Museum of the Academy of Sciences at Leningrad.

Description.—This is apparently the most pallid of the races, in accord with its desert habitat. A specimen from twenty miles southwest of Urga, in winter pelage, has the lips, sides of neck, flanks and feet and entire under side of the body white; a whitish line runs from the muzzle, below the eye, and, touching the white eye-ring, to near the base of the ear. The top of the nose is pinkish ("vinaceous buff"), and the rest of the upper side pale buff finely lined with evenly distributed black hairs. The tail is buff above and below, its terminal half above and terminal third below bordered with black and fringed with white. Summer skins are not at hand, but are doubtless less pallid, and with the back darker.

The sole of the hind foot is densely haired to the level of the four conspicuous pads. The ear is very short, in dried specimens a low rim. The short tail is from a third to a fourth the head and body length.

Measurements.—In size this, the typical race, is apparently not different from the others, but measurements of fresh specimens are not available.

Occurrence and Habits.—Little is known of the range of this subspecies, but it is probably characteristic of the northern edge of the Gobi in extreme northern Mongolia and the adjacent borders of Siberia. Pallas found it "circa Tarei lacum exsiccatum Davuriæ et ad Onon-Borsa rivum." Radde (1862) obtained it in the same region, and Dr. R. C. Andrews secured a single specimen twenty miles southwest of Urga. It apparently does not extend far into the Gobi, but follows around the northeastern edge to reappear in Chinese territory along the borders of Hopei. It is not altogether clear whether those found in the grasslands of the southeastern edge of the Mongolian plateau are the same, but at present they are considered identical with the race *C. d. mongolicus*. To the westward, again, they appear to darken slightly, but a sufficient series of comparable summer skins is needed before the status of these animals can be satisfactorily determined.

Specimens examined.—One only, from twenty miles southwest of Urga, Mongolia.

299. *Citellus dauricus mongolicus* (Milne-Edwards)

Spermophilus mongolicus Milne-Edwards, Ann. des Sci. Nat., Zool., ser. 5, vol. 7, p. 376, 1867.

Spermophilus (Colobates) mongolicus Milne-Edwards, Recherches pour servir à l'Hist. Nat. des Mammifères, p. 157, pl. 17, fig. 1, 1868-74.

Citellus mongolicus Trouessart, Cat. Mamm. Viv. Foss., p. 340, 1904.

Citellus mongolicus umbratus Thomas, Abstract Proc. Zool. Soc. London, December 22, 1908, p. 44; Proc. Zool. Soc. London, for 1908, p. 970, 1909.

Citellus dauricus mongolicus G. M. Allen, Amer. Mus. Novitates, no. 163, p. 2, 1925.

Type specimen.—Milne-Edwards based the name upon specimens sent by Père Armand David from "la Mongolie chinoise et dans le voisinage de Pékin," so that Thomas considered the type locality to be Suanhwafu, Hopei, China. The original specimens are no doubt still in the Muséum d'Histoire Naturelle at Paris.

Description.—This is a slightly darker, more ruddy race than the typical form, although specimens in pale winter pelage are very little different from these latter. A winter skin from Peiping differs in the pale buffy chest and belly, instead of white, while the same tint extends to the sides of the neck and body, and the limbs and backs of the hands. The upper side of the nose to the level of the eyes is pale ochraceous buff, passing into the still paler pinkish buff of the back of the head and the dorsal surface of the body. The nape is grayish buff, lacking the pink tint. The individual hairs of the back have a broad subterminal ring of pale ochraceous and a whitish tip, sometimes, however, with the extreme point blackish; sprinkled evenly among these are a few all-black hairs. There is a very short under fur, consisting of much finer hairs with dark slaty bases and white tips. On the lips, chin and throat the hair is white to the roots. The tail is like the back on its dorsal side, except that on the terminal half the hairs develop a long subterminal black band with a white tip, while at the base of the tail the black band is largely lacking, although a few hairs have it. Its under side is chiefly pale ferruginous, with a border of black and a white fringe in the terminal third. These longer hairs wear away as the season progresses, so that in some specimens the black border is no longer evident.

In summer pelage the entire crown and mid-dorsal area are distinctly reddish—near "vinaceous cinnamon"—with a greater admixture of black or black-tipped hairs. The sides, limbs, and belly are pale yellowish, the lips, chin, and eye-ring white. The last is more sharply defined than in winter pelage, and is bordered above by a slightly darker crescent-shaped line, while the cheeks below the eye have a band of the same "vinaceous cinnamon" as the top of the head, extending from muzzle to ear, and containing a number of longer black hairs. The tail is as in winter.

The skull in its general structure is a smaller replica of that of *C. eversmanni jacutensis*, with the zygomata sloping gradually backward, instead of bowing abruptly outward as in *C. pallidicauda*. The teeth are narrower and more compressed in an antero-posterior direction than in the former, with their

enamel pattern slightly simpler in that there is no tendency for the posterior enamel fold to form a raised cusplet on its inner half in the upper molars as it does in the larger species, while the ledge on the anterior border of these molars is proportionally much narrower.

Measurements.—The following flesh measurements were all from a series secured by the American Museum Asiatic Expeditions at Tabool, Mongolia:

No.	Head and body	Tail	Hind foot	Ear
57447	190	55	38	9
57449	195	55	37	5
57450	195	60	38	8
57451	200	60	38	7
57452	195	55	36	7
57454	190	55	38	8
57455	200	60	38	9
57456	210	65	39	10

CRANIAL MEASUREMENTS OF *CITELLUS*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
<i>C. dauricus dauricus</i>									
57448	45.8	40.8	25.0	27.9	21.2	13.2	9.6	8.6	Mongolia
<i>C. dauricus mongolicus</i>									
57449	46.7	—	—	28.0	22.2	12.5	9.0	9.0	Mongolia
38355	48.0	41.8	26.5	27.6	21.3	12.7	9.4	8.5	Shantung
57454	43.8	37.4	24.9	28.1	21.7	12.8	9.3	8.3	Mongolia
8.3.5.5 BM (type of <i>C. m. umbratus</i>)	45.9	40.0	25.2	27.7	21.7	12.6	9.9	8.9	Mongolia
8.3.5.3 BM	44.8	39.5	25.0	26.3	20.3	12.6	9.7	8.7	Mongolia
8.3.5.10 BM	42.7	37.2	24.0	24.7	20.4	12.5	9.5	8.9	Mongolia
19.7.7.2330 BM	—	40.5	26.2	28.2	21.9	13.6	10.0	9.5	Hopei
<i>C. dauricus obscurus</i>									
58233	46.1	40.5	25.0	28.8	21.7	12.8	10.2	9.2	Mongolia
58234	43.3	38.6	23.5	27.5	21.0	13.0	10.0	9.1	Mongolia
<i>C. dauricus alaschanicus</i>									
19924 MCZ	44.8	49.3	24.0	28.6	—	12.8	10.0	9.0	Shansi
9.1.1.62 BM	46.5	40.5	25.3	28.6	22.0	12.5	10.0	8.7	Shensi

Occurrence and Habits.—Compared with typical *C. dauricus* this is a more intensely colored race, with the back of a distinctly ruddy tint, darker than in the more northern animal. It ranges from central Jehol southward to Shantung and westward probably at least into central Shansi, intergrading by

imperceptible degrees with the paler race *C. d. alaschanicus* in the western part of Shansi. A single specimen was recorded by Dr. J. A. Allen (1909a, p. 430) from the "foot of Tai-pa-shiang" that may represent the southwestern limit of the range, and perhaps is such an intermediate. Thomas (1908) described as a subspecies *umbratus* the animal from the grasslands at the edge of the Gobi some one hundred miles northwest of Kalgan, Hopei, but a comparison of topotypes does not reveal any substantial difference, and after an examination of the skins in the British Museum, it now appears clear that Thomas was misled by the fact that all his series from that region were in the dark summer pelage, whereas those from Yulinfu, with which he compared them, were still in the winter coat which is much paler. One of the Kalgan specimens is very young, perhaps ten days old, and is interesting in that it is distinctly pinkish on the forehead and back as in the adult winter pelage, notwithstanding that the adults taken at the same time are in the darker summer fur. Of the series taken by Dr. R. C. Andrews in the course of his traverse of this same area, those taken up to May 1 were still in worn winter coat which in specimens collected May 18 is just beginning to change to summer. He found this ground squirrel all along the caravan route in suitable places as far as one hundred and thirty miles northwest of Kalgan. He writes that it is common, and characteristic of the grasslands of this area of Inner Mongolia, living in colonies, but it does not extend up to the edge of the desert at Pang Kiang. He found it unsuspicious and easy to trap or shoot.

As to the breeding habits, one of the specimens in the British Museum taken at Yulinfu, Shensi, on May 8, 1908, has the note on the label that it contained five embryos, each about 21 mm. long. The young are probably born in June, for a very small one was collected at Tsinanfu, Shantung, on July 4, and others about a third grown on July 17 and 19. Concerning its habits in North China, Sowerby (1914) says that it feeds upon different herbs and small plants and often works havoc in grain fields. These animals keep a sharp watch for enemies while on foraging expeditions and dive into their burrows on any alarm, but seem rather fearless of man. "They may often be seen sitting up like sentinels upon the mounds of earth, which they raise beside their burrows." They are of diurnal habits, and pass the winters in hibernation.

Messrs. Jordan and Rothschild (1911) have described two new fleas, *Ceratophyllus mandarinus* and *C. mongolicus*, from this ground squirrel.

Specimens examined:—The following sixty-eight:

China:

Jehol: Chihfeng, 3 (B.M.).

Hopei: Peiping, 2 (A.M.N.H.), 3 (B.M.); Suanhwafu, 1 (B.M.).

Shantung: Tsinanfu, 10.

Shensi: Chingpien, and vicinity, 3 (B.M.); Yulinfu, 8 (B.M.).

Mongolia:

Tabool, one hundred miles northwest of Kalgan, 9 (A.M.N.H.), 11 (B.M.); sixty miles northwest of Kalgan, 1 (B.M.); one hundred and thirty miles northwest of Kalgan, 14 (A.M.N.H.); Khara Usu, forty miles northwest of Kalgan, 3 (B.M.).

300. *Citellus dauricus alaschanicus* (Buechner)

Spermophilus alaschanicus Buechner, Wiss. Resultate d. v. Przewalski Reisen, vol. 1, Säugethiere, p. 11, pl. 2, fig. 1, 1888.

Citellus alaschanicus Trouessart, Cat. Mamm. Viv. Foss., p. 337, 1904.

Citellus mongolicus Thomas, Proc. Zool. Soc. London, for 1908, p. 970, 1909.

Citellus obscurus siccus G. M. Allen, Amer. Mus. Novitates, no. 163, p. 3, 1925. Taiyuanfu, Shansi.

Citellus alaschanicus alaschanicus Obolenski, Compt. Rend. Acad. Sci. URSS, 1927A, p. 192.

Type specimen.—This name is based on a single skin with a skull so fragmentary as to be useless for comparison, No. 2127, in the collection of the Academy of Sciences at Leningrad. It was collected in southern Alashan, Mongolia, in August, 1880, by Przewalski's expedition.

Description.—A pallid desert race, differing from *C. d. mongolicus* in its pale pinkish-buff dorsal area and pale buffy-white flanks. There is the usual white eye-ring, a light rusty-brown spot below the eye separated from the ring by a whitish stripe that runs from the muzzle to the base of the ear. The tail is like the back above, but rusty red below, the terminal hairs with long rusty-white tips.

Measurements.—Buechner gives the following measurements of his type and only specimen: head and body, 217 mm.; tail vertebræ, 42; to the ends of the hairs, 65; hind foot, 37. There seems to be therefore complete agreement in size with other members of the *C. dauricus* group.

For cranial measurements, see table under *C. d. mongolicus*.

Nomenclature.—Further study of a considerable series of specimens convinces me that Buechner's *Spermophilus alaschanicus* is really not a distinct species at all but merely a pale desert representative of *C. dauricus* of which it therefore should stand as a subspecies. It was based on a single skin without a complete skull, and the specimen is excellently figured in Buechner's plate. This plate and his description show a close agreement in all important structural details with the typical race of *C. dauricus*, and I further believe that the pale animal I described as *C. obscurus siccus* is the same.

Occurrence and Habits.—The range of this pallid, pinkish-backed race is still to be better defined, but at present may be regarded as extending from central Shansi westward across Shensi to the Ordos Desert and to Alashan. In addition to the specimen that I described as *C. o. siccus* from Taiyuanfu, Shansi, Thomas has recorded specimens (as *C. mongolicus*) from Chingpien, northwestern Shensi, the Ordos Desert, and Yulinfu, Shensi. Sowerby found it "particularly plentiful in and round the Ordos Desert," in dry or sandy districts as well as on flat plains, and says that the Chinese name is "sha-shu,"

meaning Sand Rat. Potanin, the Russian explorer, in 1884, also found it in several places in the plains south of Kukukhoto and north of Mantou, Shansi, as well as in the Ordos (Buechner, 1892, p. 157). A. B. Howell (1929) has referred specimens from Tungkwan and Sianfu, Shensi, as well as others from Lanchowfu and Chingningchow, Kansu, all to *C. d. mongolicus*, but while it must be admitted that the distinctions are slight and rest chiefly on slight differences in the tint of the upper parts, it is perhaps justifiable to consider these slightly paler desert animals as a separate race.

Specimens examined:—Two (the type and a topotype of *C. obscurus siccus*) from ten miles west of Taiyuanfu, Shansi.

301. *Citellus dauricus obscurus* (Buechner)

Spermophilus obscurus Buechner, Wiss. Resultate d. v. Przewalski Reisen, vol. 1, Säugethiere, p. 17, pl. 2, fig. 2; pl. 4, figs. 7-9, 1888.

Citellus obscurus Trouessart, Cat. Mamm. Viv. Foss., p. 340, 1904. G. M. Allen, Amer. Mus. Novitates, no. 163, p. 2, 1925.

Citellus alaschanicus obscurus Obolenski, Compt. Rend. Acad. Sci. URSS, 1927A, p. 192.

?*Citellus alaschanicus dilutus* Formosov, in Obolenski, Compt. Rend. Acad. Sci. URSS, 1927A, p. 192. Mongolian Altai, Ikhe Bogdo.

Type specimen:—The name is based on three specimens, cotypes, Nos. 2122, 2125, 2126, all males, from north of Tschagryn-gol (?Shagrin Gol), Kansu, China. They were collected by the explorer Przewalski, and brought back to the Museum of the Academy of Sciences, Leningrad, U.S.S.R.

Description:—Similar to *C. dauricus dauricus* but the dorsal coloration, at least in the summer pelage, is slightly darker. The general color above is an even mixture of dull buffy and black, producing a dark sandy color, as well illustrated in Buechner's plate, wholly lacking the decided ruddy tinge of summer skins of *C. d. mongolicus* or the pinkish tint of *C. d. alaschanicus*; even the contrasting pinkish tint of the top of the nose is lacking. In other respects the coloring is not very different. The tail is probably on the average slightly longer, as the measurements given below, as well as those of Buechner, seem to show.

Measurements:—The following measurements of fresh specimens were made in the field by the collector:

No.	Head and body	Tail	Hind foot	Ear	Locality
57460	210	70	—	—	Mongolia
57461	195	70	39	—	Mongolia
58233	205	75	42	8	Mongolia
58234	190	70	39	7	Mongolia
58235	195	75	39	8	Mongolia
58237	196	70	40	8	Mongolia
58239	190	71	40	8	Mongolia
58240	197	72	36	7	Mongolia

Buechner says that the tail measured in the fresh specimen was 76 mm. Cranial measurements are given in the table under *C. d. mongolicus*.

Nomenclature.—Although described as a separate species by Buechner, it seems now fairly clear that this is merely a slightly darker subspecies of *C. dauricus* with which it agrees in size, the hairy sole, the short tail, and in cranial characters. Obolenski (1927) regarded it as a race of *C. alaschanicus*, which itself is undoubtedly a form of the same species, while at the same time he introduces a new name accredited to Formosov (*in litt.*) for the animal of the western Gobi, said to have the back grayer, less yellowish rufous, and the diastema longer than the molar teeth. Both these characters seem difficult to appreciate for the differences in tint are not great and the diastema is regularly longer than the maxillary tooth row in *C. dauricus*. Until a thorough study of the species with much more comparable material from the different parts of its range can be made, it must be said that the conclusions that have been here reached are more or less tentative so far as the definition of the various subspecies is concerned.

Occurrence and Habits.—This race seems to be the one found not only in western Kansu but also in western Mongolia. The original specimens came from north of "Tschagryn-gol," and one of them is figured in color by Buechner. The series secured by the Central Asiatic Expeditions in western Mongolia, chiefly in Artsa Bogdo, corresponds closely to *C. d. obscurus* in its dark sandy tint, and I have provisionally referred it to that race. Specimens from Lanchow, Kansu, are regarded by Matschie as *C. d. obscurus* but by Howell (1929) as *C. d. mongolicus*. In addition to the series from Artsa Bogdo, the Central Asiatic Expeditions secured a single female at thirty miles northeast of Tsetsen Wang that seems to be the same. The range, then, probably includes northwestern Kansu and the western parts of Mongolia, but is as yet imperfectly made out. As elsewhere in the range of the species, it seems to be characteristic of grass country, for Dr. Andrews writes that at Artsa Bogdo it was fairly abundant on the grassy slopes of the lowest foot-hills.

Specimens examined.—In all, twenty-one, as follows:

Mongolia: Artsa Bogdo, 20; thirty miles northeast of Tsetsen Wang, 1.

302. *Citellus pallidicauda* (Satunin)

Spermophilus pallidicauda Satunin, *Annuaire Mus. Zool. Acad. Imp. Sci. St. Pétersbourg*, vol. 7, p. 551, 1902.
Citellus pallidicauda Trouessart, *Cat. Mamm. Viv. Foss.*, p. 337, 1904.

Type specimen.—A female, skin and skull, from Chulmu Nor, Gobi Altai, Mongolia. Collected in September, 1899, by the P. K. Kozlov Expedition, and now in the Museum of the Academy of Sciences at Leningrad. Number not given.

Description.—A pale species characterized by its tail which is all white except for the middle of the upper three-fourths which is rusty. The summer

and winter pelages seem to differ but little. A specimen taken May 21 and apparently representing the winter coat has the top of the snout rusty ("tawny ochraceous"), shading on the forehead into sand color. The entire dorsal region is pinkish buff, the individual hairs having a short dark base, then a broad ring of vinaceous, and a short white tip. A few all-black hairs are mixed with these, but not sufficient in quantity to darken the general hue. An ill-defined white stripe passes from the base of the vibrissæ to the ear, and the eyelids are white. A rusty spot below each eye, from which project a few longer black hairs. A whitish stripe extends below this mark from the tip of the muzzle back along the side of the head, with very indefinite boundaries, and merges with the whitish sides of the neck and the flanks. The entire under parts and the limbs and feet are white, more or less faintly tinged with buffy. The bases of the hairs on the chest and venter are slaty, but on the chin are white. The short tail is about a quarter the length of the head and body, rusty or "tawny ochraceous" in the center above and below, fringed with long white tips. The complete lack of black hair in the tail is a unique and distinctive character. The lower side of the hind foot is quite naked to within about 7 mm. of the heel.

In the summer coat (June 25) the coloring is slightly more sandy and less pinkish buff, but the difference is apparently not great.

The skull is rather peculiar as compared with other eastern species in its short rostrum and abruptly flaring zygomata which are wide and strong. The superciliary region is raised to form a bony rim projecting upward and outward conspicuously from the lachrymal region to and including the supraorbital processes. The brain case is relatively short, so that in profile view the posterior border of the zygomatic root is above the first third of the audital bulla which itself is full and smoothly globular, proportionally more inflated than in *C. evermanni jacutensis*.

Measurements.—The following are the collector's measurements:

No.	Head and body	Tail	Hind foot	Ear	Locality
57464	230	50	40	—	Mongolia
57465	238	47	45	—	Mongolia
60416	209	50	39	4	Mongolia
60417	210	55	43	5	Mongolia

CRANIAL MEASUREMENTS OF *CITELLUS PALLIDICAUDA*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
45731	45.7	40.5	26.5	32.5	25.5	14.0	11.3	10.2	Mongolia
57464	43.2	40.0	25.0	31.8	25.1	14.7	10.4	10.2	Mongolia
57465	47.4	43.0	27.3	32.3	26.3	14.2	10.5	10.2	Mongolia
57468	44.3	39.7	25.2	28.9	24.3	13.1	11.2	10.2	Mongolia

Occurrence and Habits.—Easily distinguished from all the other eastern ground squirrels by its pale coloring, with russet-tipped muzzle from nose to eye dorsal to the vibrissæ, and by the tail which is white with a rusty mid-dorsal stripe, quite without black hairs, this species has a wide range in the grasslands of the Gobi. Dr. Andrews first met with it about one hundred miles beyond Ude (a telegraph station midway on the road from Kalgan to Urga) where "after passing through a desert area one comes to a more grassy, rolling section. As we came up on a small plateau studded with ragged shale outcrops, we first noticed these gophers. They continued for about forty miles north and south beyond this ridge and into a grassy region where there are many small ponds that dry up in the summer. I should say they ceased about 140 miles beyond Ude, being confined to a belt of about forty miles. They were extremely shy, running for their holes and diving into them as soon as we approached. They lived in colonies like the southern species [*C. d. mongolicus*] but were not as abundant . . . Their range is separated from that of the latter by about 350 to 400 miles of country in which no *Citellus* occurs as far as I have seen while traveling between Kalgan and Urga." Still farther to the west, Dr. Andrews secured a specimen at Gun Burte, which seemed to mark their northern extension. They were uncommon here, however, but appeared again much more numerous at Uskuk, living in large colonies. They seem to occur therefore in north-south belts of no great width, although their distribution from east to west is extensive. This, writes Dr. Andrews (MS. notes), "I suspect to be true of all the plains- and desert-living *Citellus* of this country. As one goes north and south there are fairly rapid changes of country, while in an east and west direction the environment does not change in a short distance." Other specimens were secured at Loh, Shabarakh Usu and Ula Usu. The westward limit may be represented by the single specimen on which Satunin based the species, from Chulmu Nor at 6,800 feet in the Gobi Altai.

Specimens examined.—In all, thirty, as follows:

Mongolia: Ude, 8; Uskuk, 17; Loh, 1; Shabarakh Usu, 1; Ula Usu, 2; Gun Burte, 1.

Genus **Marmota** Frisch

MARMOTS

Marmota Frisch, Das Natur-System vierfüss. Thiere, in Tabellen, p. 9, 1775. Blumenbach, Handbuch Naturgesch., vol. 1, p. 79, 1779.

Arctomys Schreber, Säugthiere, pls. 207-211, 1780; text, vol. 4, pp. 721-743, 1782.

Stout-bodied, almost badger-shaped animals, with short, rounded ears, short and slightly flattened tails, strong feet with stout claws for digging, the marmots at first sight bear little resemblance to the true squirrels, of which, nonetheless, they represent a ground-living, burrowing modification. In the fore foot the first digit is vestigial, with a very small flattened nail in all but the

European *M. marmota*, the type species of the genus. On account of this peculiarity, Pocock has proposed to set apart the latter as a distinct genus, and to include the other marmots, with a nailed thumb, in a new genus, *Marmotops*, type species *M. monax*, of North America. The character seems in itself of relatively slight importance, so that it would perhaps be more convenient to regard it as of subgeneric value only.

The skull is heavily built, triangular in outline, and so flattened that the occipital depth through the bulla equals that from the anterior end of the alveolar line to the summit of the skull, while so stout is the muzzle that the same diameter equals the distance from the tip of the nasals to the point of the upper incisor. The postorbital processes are strong, nearly transverse, and curve out and down. The posterior face of the skull is nearly perpendicular, forming a half circle, bordered by high lambdoid crests for insertion of the powerful neck muscles. A low sagittal crest extends forward to the level of the squamosal process, then forks, sending a branch to the back of each postorbital process. The upper tooth rows diverge slightly. The anterior premolar is large and functional, its nearly circular crown-area nearly half that of the second. The crowns of the three middle upper molariform teeth have each two transverse ridges, with an anterior lower ridge set off by a cross-valley. The last molar is the largest. Each of the lower teeth has two low external cusps, the anterior of which is continued across to form the anterior border of the rather rhombic tooth. The stout incisors are usually pale yellow externally, with the enamel minutely fluted. The tooth formula is: $i. \frac{1}{1} c. \frac{0}{0} pm. \frac{2}{1} m. \frac{3}{3} = 22$.

The baculum, as indicated by Pocock (1923), bears a certain resemblance to that of *Citellus*, but is relatively very small, an irregular flattened rod, slightly sigmoid in outline as seen from above, "ending simply with a few irregularly placed denticles." The mammae are ten or twelve, of which three pairs are pectoral, two inguinal.

This is essentially a boreal genus, inhabiting open and rocky places, making burrows for shelter. Three species occur in China and Mongolia, one the Bobak confined to the Gobi, the others mountain species entering western China from the Tibetan highlands. They may be known by the following key:

KEY TO CHINESE AND MONGOLIAN SPECIES OF *Marmota*

- A. Back mottled black and buffy, tail less than twice length of hind foot..... *M. himalayana robusta*
- B. Back without mixture of black, tail at least twice length of hind foot.
 - a. Fur of back tawny, tail about half length of head and body... *M. littledalei flavinus*
 - b. Fur of the back whitish, tipped with fulvous or brown; tail about a third the length of head and body..... *M. bobak sibirica*

303. *Marmota himalayana robusta* (Milne-Edwards)

SZECHWAN MARMOT

Arctomys robusta Milne-Edwards, Recherches pour servir à l'Hist. Nat. des Mammifères, p. 309, pl. 47; pl. 49, fig. 2, 1868-1874.

Arctomys robustus Milne-Edwards, in David, Nouv. Arch. Mus. d'Hist. Nat. Paris, vol. 7, Bull., p. 92, footnote, 1871.

Arctomys himalayanus De Winton and Styan, Proc. Zool. Soc. London, 1899, p. 575.

Marmota robusta Lyon, Smithsonian Misc. Coll., vol. 50, p. 134, 1907.

Arctomys himalayanus robustus Jacobi, Abh. u. Ber. Mus. f. Tier- u. Völkerk., Dresden, vol. 16, no. 1, p. 10, 1922.

Marmota himalayana robusta A. B. Howell, Proc. U. S. Nat. Mus., vol. 75, art. 1, p. 36, 1929.

Type specimens.—The original specimens were sent to the Paris Museum by Père Armand David, who secured them in the principality of Muping, central Szechwan, China.

Description.—Top of the nose and the area between the eyes, blackish, becoming mixed with buffy over the forehead; sides of the muzzle from the nose-pad to the eye and a narrow area from the eye to the base of the ear, bright ochraceous to ochraceous-rufous, forming an ill-defined stripe. Entire remainder of the back, a rather even mixture of buff and black, hardly darker in the midline. The cheeks and the fore limbs, the fore and hind feet, clear buff, with a very few black vibrissæ and scattered hairs on the cheeks. Entire under surface of the head, body, and limbs "orange buff," the hairs everywhere with dark, slaty-black bases. Tail at the extreme base above like the back, then a nearly clear-buffy band, succeeded by a black fringe at the sides of the terminal half and an all-black tip about an inch in length. On its lower side the tail is black, with the tips of the hairs at the base and scatteringly along the sides, ochraceous.

The skull is large and heavily formed, with stout tapering postorbital processes, a low but sharp sagittal crest, nasals exceeding the posterior extension of the premaxillæ by about 7 mm., and so reaching the level of the anterior third of the orbit, instead of being about on a level with its anterior rim as they are in *M. bobak sibirica*.

Measurements.—An adult female measured: total length, 705 mm.; tail, 135; hind foot, 88.

The skull measures as follows:

CRANIAL MEASUREMENTS OF *MARMOTA HIMALAYANA ROBUSTA*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
7584 MCZ	104.0	95.0	57.0	62.2	47.0	26.1	22.2	21.5	Szechwan
22.9.1.82 BM	108.3	103.7	62.4	66.0	50.3	26.7	24.3	23.7	Yunnan
11.2.1.95 BM	104.0	99.1	59.8	69.2	47.4	30.0	24.5	22.4	Kansu
11.2.1.94 BM	101.4	94.6	58.1	63.3	46.6	27.4	25.5	22.7	Kansu
96.11.4.9 BM	100.9	95.6	59.0	66.4	47.7	27.2	23.7	21.7	Szechwan

Occurrence and Habits.—This handsome marmot may readily be dis-

tinguished by its bright rufous ears, the evenly mixed black and buff coloring of the back, pale-ochraceous belly, and by the short flattened tail with its black tip. It lives at high altitudes and reaches the extreme western edge of the Chinese highlands as an invader from the Tibetan plateau. No doubt A. B. Howell (1929) is right in considering it merely a subspecies of the more western *M. himalayana* which apparently differs in being grayer, without the more ochraceous tints of *M. h. robusta*, and in having the black of the forehead less extensive. De Winton and Styan (1899), however, regarded it as identical with typical *M. himalayana*, and mention specimens from northwestern Szechwan which they compared with others from Sikkim. After examining the type of the latter and other specimens in the British Museum, I am inclined to agree with them, but in view of the paucity of specimens available, I have retained it for the present. It was originally described from specimens sent from the mountains of Muping, central Szechwan, by Père David, who said that it is here found only in the highlands of Poemalou and "Yaotchy" along the area of perpetual snow. W. R. Zappey in 1907 obtained it slightly to the westward at Shuowlow at an altitude of 15,500 feet, while Thomas has twice recorded it (1912b, 1922b) from the region of Atuntze, northwestern Yunnan, at altitudes of from 14,000 to 15,500 feet in rocky alpine meadows. Slightly farther north it occurs at Sungpan, northwestern Szechwan (Jacobi, 1922), and in western Kansu, north of the Min Shan, at Taochow (Taocheo), as recorded by Lyon (1907) and Thomas (1911d). Practically nothing is recorded of its habits, but according to David it spends the winter in hibernation as do other marmots. A specimen obtained by Zappey at Kaoerh Shan, western Szechwan, August 28, 1908, is evidently a young of the year, already well grown but retaining the milk premolars, while at the same time the three molars of each series are all in place. A. B. Howell (1929) records specimens in the U. S. National Museum from Ngangyangba, Szechwan, and from one hundred miles southwest of Lanchow and Archuen, Kansu, the latter localities representing about the limit of its northeastward range, so far as known. On the Tibetan border Brooke Dolan traced it from Cheto Pass, and Tsongbenla (16,000 feet) to Litang.

Jordan and Rothschild (1911, pp. 374, 375, 381) figure and describe three new species of flea from specimens of this marmot from Taochow, Kansu, namely, *Ceratophyllus dolabris*, *C. crassus*, and *C. famulus*.

Specimens examined.—The following nineteen:

Szechwan: Kaoerh Shan, 1 (M.C.Z.); Shuowlow, 15,500 feet, 1 (M.C.Z.); without exact locality, 2 (skins only); Sungpan, 1 (A.N.S.P.), 1 (B.M.); Yangliupa, 1 (B.M.); Cheto Pass, 1 (A.N.S.P.); Tsongbenla, 1 (A.N.S.P.); Litang, 3 (A.N.S.P.).

Yunnan: mountains east of Atuntze, 4 (B.M.).

Kansu: Taochow, 2 (B.M.); no exact locality, 1 (B.M.).

304. *Marmota bobak sibirica* (Radde)

THE TARBAGAN OR BOBAC

Arctomys bobac sibirica Radde, Reisen im Süden von Ost-Sibirien, vol. 1, p. 159, frontispiece, 1862.

Arctomys bobac Preble, U. S. Public Health Service, vol. 27, p. 31, 1913. Wu Lien-teh, China Journ. Sci. and Arts, vol. 1, p. 39, 1923.

Marmota bobak sibirica G. M. Allen, Amer. Mus. Novitates, no. 163, p. 4, 1925.

Marmota sibirica Wu Lien-teh, Bull. Dept. Biol., Yenching Univ., Peking, vol. 1, p. 95, 1930.

Type specimen.—Radde unintentionally became the authority for the subspecies, stating that Brandt in a forthcoming publication proposed to call the variety of Siberia by the name *A. b. sibirica*, basing his account largely on that of Pallas. Probably the region between Tarei Nor and Lake Baikal in the extreme northeast of Mongolia may be considered the place of origin of Pallas's specimens. It is not known to me whether any of his material is still extant.

Description.—Two general types of coloring occur, a browner and a more fulvous. The top of the head from the nose-pad to about the level of the ears is uniform brown, varying from "seal brown" to "vandyke brown," but this area does not include the ears. All the rest of the upper surface from the occiput to and including the basal half of the tail consists of hairs with a short concealed base of brown or blackish brown, succeeded by a broad white ring, and tipped with a long point of either bright fulvous or vandyke brown. Sides of the face below the eyes, sides of the neck, the limbs and feet, nearly uniform pale ochraceous to buff, the distinction between the white rings and fulvous tips much less than in the dorsal hairs. Central area of the ventral side from the whitish lips to the base of the tail, a uniform "ochraceous" to "clay color," the hairs with very short dark-brown bases; the inguinal region sometimes more or less blackish. Terminal half of the tail rusty brown above and below.

The skull does not differ greatly from that of *M. himalayana robusta*, although it does not, apparently, attain such a large size. The nasals are broader posteriorly and their backward extension is slightly less; the postorbital processes, as pointed out by Miller (1912), have their posterior border more nearly in a transverse line instead of curving back and down. These processes are, however, not so close to the brain case as figured by that author for the Bobac of eastern Europe.

Measurements.—Only cranial measurements are available.

CRANIAL MEASUREMENTS OF *MARMOTA BOBAC SIBIRICA*

No.	Greatest length	Basal length	Palatal length	Zygomastic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
57366	88.5	81.5	47.0	55.8	40.5	25.9	22.0	20.5	Mongolia
57368	104.0	93.5	55.6	61.1	46.3	27.5	22.8	21.5	Mongolia
57369	88.7	80.7	48.3	56.8	43.7	24.6	20.5	20.2	Mongolia
43658	93.5	86.8	50.6	57.0	43.2	24.6	21.0	21.6	Mongolia
58226	95.7	88.6	52.6	59.6	43.6	25.5	21.5	20.4	Mongolia

Occurrence and Habits:—The Bobac is markedly colonial, living in more or less scattered communities in the grasslands and rolling country of the Asiatic steppe across to the Amur region. It avoids sandy wastes so is not found in the central Gobi, but is common in suitable localities over much of the northeastern end. Dr. Andrews writes that on the caravan journey from Kalgan to Urga he first saw old marmot holes "among the rocks at Tuerin, but no animals, for they had evidently all been killed off. About 30 miles northwest of Tuerin on the Urga road they begin to be abundant and continue up to Urga. When we went west in the Tola valley we saw a very few, but as this is a favorite camping ground for Mongols on account of the good grazing, they had all been killed off. In 1919 we saw only one in going ninety miles along the river valley, but as soon as we turned southwest toward Tze Tzen Wang we saw them in great numbers and got a good many. They continued to be abundant to Tze Tzen Wang but we saw none at the camp forty miles southwest of there, nor between that place and Sain Noin Khan, why I do not know, for conditions were favorable and there were very few Mongols. We saw half-grown young at Tze Tzen Wang, but not many. In 1919, from June 12-30 I saw a great many young and caught many. They were about the size of ground squirrels and played about like kittens on the green grass at the entrance of their holes. At Uskuk, Granger saw a few marmots but I saw none and we did not collect any. Shackelford also reported seeing marmots a little east of Uskuk. There were none about Loh or Tsagan Nor and conditions were not favorable for them there. At Artsa Bogdo on the grassy slopes well up in the mountains, I saw a number of marmot holes and two adults and three young, the latter about two-thirds grown on August 23. They had the brown winter pelage."

An excellent account of this marmot was written by Radde (1862, p. 158) who had abundant opportunity to see the species along the northeast border of Mongolia. Approaching from the Siberian side, he first met with them at the border posts Narasün and Nishne-Utchim on the upper Onon River. They were common about Tarei Nor in the stony barren hills and mountains. Although more or less dependent upon grass country, they often live in regions where for considerable periods they can obtain no fresh water for drinking, so may sometimes be seen in the early morning licking dewdrops from the grass stalks. The forenoon is their time of greatest activity. Their enemies are chiefly the eagle, large hawks, and wolves, in addition to the dogs of the Mongols. The chief mortality seems to be among the young that play unsuspectingly about their burrows in early summer, for the old ones are shy, and on the approach of danger drop back into their holes, there to wait until their alarm has subsided. In the first half of September they disappear for the hibernating season and do not come out again until about the middle of March.

They are the first of the hibernators of the high steppe to appear, sunning themselves for a brief time at noonday at first. The heavy coating of fat acquired in the previous autumn is little if any reduced on emergence, and the Mongols, knowing this, hunt them for food on their first appearance. They are either shot by the hunter, who hides near their burrow awaiting their reappearance, or are taken in snares. Their subcutaneous fat very soon is lost, however, and by April they often become very thin and poor, many frequently succumbing before the new spring growth of grass furnishes them nourishment. Usually, however, by the end of May, with the growth of *Elymus* and other vegetation, they have regained condition. The summer burrows are different from those occupied in winter. The latter were dug out by Radde on several occasions, and he records finding them thoroughly stopped with earth and gravel for some distance. The deeper part of this plug must have been formed some time later than the outer, for it is partly mixed with feces, bits of grass root, and finally more or less cemented by urine.

Wu Lien-teh (1923, 1930) has studied this species in regard to its connection with plague, particularly pneumonic plague. In the course of his investigations, this author had occasion to excavate several burrows, of which he gives diagrams. These vary in length, but seldom reach a depth of more than five to seven feet, so that as the ground freezes in winter to a depth of about six feet, the bobacs must hibernate within the frost belt. Wu found that these winter holes are deeper than those occupied in summer, and have but a single opening instead of several. The opening is plugged in winter with compacted grass, twigs and damp earth. Usually from two to four animals are found in such a hibernation burrow, but as many as fourteen have been known to occupy one. A small amount of winter food is stored in the burrow in the shape of grass, roots and seeds. Wu indicates in his diagrams an enlarged chamber usually slightly above the level of the hibernating chamber, in which feces are deposited during the period of underground life. Mating probably takes place in April and young are found in July. Bobacs are extremely powerful. Wu found that they could escape from a cage made of stout board and lined with iron rods half an inch in diameter by gnawing away the wood and bending the rods. Their colonial life has a modifying influence on the face of the land, for their villages give an obvious irregularity to the surface, which is thrown into undulations where the earth mounds rise in front of the burrows. It is said that this constant working over of the soil has a certain beneficial effect on the vegetation, and often the newly excavated earth about the burrows supports vegetation not found elsewhere in the vicinity. The animals are much hunted for their fur which is used to imitate marten. They are therefore protected during July and August in China, but hunted or dug from their burrows at other times.

These marmots harbor fleas and ticks as parasites, the flea being *Ceratophyllus silantievi* Wagner, the tick a species of *Rhipicephalus*. The former is suspected of being a transmitter of the plague bacillus. In 1911 an outbreak of this scourge caused some 50,000 deaths among the natives and another in 1921 accounted for some 9,000. The Mongols exercise a good deal of care to avoid touching a sick animal, but the Chinese are less particular, and possibly this may in part account for the comparative immunity of the former. Experiments show that the bobacs can be given plague experimentally by spraying the nostrils with a decoction. Nevertheless, Wu concludes that "while acknowledging the existence of a form of plague in tarbagans, we are still in the dark as to the extent of this infection or to the extent of its relation in the causation of plague in man. There is as much possibility in the domestic rat playing the principal rôle."

Specimens examined:—The following series of seventy-one:

Mongolia: eighty miles southeast of Urga, 21; sixty miles southeast of Urga, 11; forty miles southeast of Urga, 9; thirty miles southwest of Urga, 4; forty-five miles northeast of Urga, 4; Tsetsen Wang, 9; thirty miles northeast of Tsetsen Wang, 6; Suok, 1 (B.M.); no exact locality, 6.

305. ***Marmota littledalei flavinus*** (Thomas)

Arctomys littledalei flavinus Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 3, p. 259, 1909.

Type specimen:—An adult female, skin and skull, in the British Museum, original number 118, from the Hissar Mountains, one hundred miles east of Samarkand, central Asia. Collected June 20, 1908, by Douglas Carruthers.

Description:—A long-tailed species related to *M. caudata* of central Asia, with the tail about half the length of head and body. The back, instead of being broadly washed with black, is wholly tawny or ochraceous tawny, cheeks and sides of the neck but little lighter than the rest of the body. Crown blackish as is also a patch on top of the nose. Hands and feet buff. Tail long, dull ochraceous tawny, with a prominent black end. Under surface between buffy and ochraceous buff. The general characters are said to be like those of *M. littledalei* but the body paler, more yellowish throughout, the individual hairs brown at their base, then cream buff in their middle zone, their ends tawny, without a black tip.

Measurements:—The type specimen measured (Thomas, 1909a, p. 260): head and body, 470 mm.; tail, 220; hind foot, 82.

Skull of the type: upper length (occiput to tip of nasals), 95 mm.; zygomatic width, 57.

Occurrence and Habits:—The claim that this marmot has a place in the fauna of Mongolia still rests on a rather insecure basis. Thomas (1909a) has recorded an imperfect skin from Suok in the Altai of northwestern Mongolia, presented to the British Museum by H. J. Elwes, that "would also appear to be referable to this form." If this record is later confirmed by the capture of additional specimens, it would be interesting as another instance of the eastward extension of a central Asiatic species to the borders of Mongolia. This specimen, however, I have since examined, and would regard it as *M. bobak sibirica*, of which Thomas had apparently none for comparison. It is quite the same in color and has a relatively shorter tail than *M. littledalei*, this member having its vertebræ still intact in the skin. Beyond this brief record nothing further seems to be known of its presence within this area, unless the specimen doubtfully recorded as *M. centralis* by A. B. Howell (1929, p. 36) is the same. This was from near the Kobdo River, Mongolia, and was "so identified by the late N. Hollister. It matches the description of *centralis* but no attempt is made to pass upon" its relationship. For the present, therefore, its final identification may await an opportunity for more thorough comparison.

Specimens examined:—None.

Family PETAURISTIDÆ

FLYING SQUIRRELS

Although in their dentition the flying squirrels of Asia and North America resemble the more typical squirrels, they all agree in the possession of a parachute membrane extending from the ankles to the wrists, where a stiff cartilaginous rod on the outer side acts as a spreader. The family comprises both large and small members, of which the latter represent several related groups currently regarded as distinct genera, one of them confined to the northern evergreen forests, the others centering chiefly in the subtropical forests of the oriental region. Among the large species are several of relatively gigantic size with rounded instead of flattened tails, comprising the members of the genus *Petaurista*, while the genus *Trogopterus* of intermediate proportions is remarkable for its enlarged and complex premolar.

The skulls of the Petauristidæ almost invariably have a characteristic appearance, due in part to the short, triangular and slightly raised postorbital processes, and in part to the distinct depression between the orbits, a result perhaps of the large crepuscular eyes, causing a flaring of the surrounding bone for their accommodation.

KEY TO THE GENERA AND SUBGENERA OF CHINESE AND MONGOLIAN PETAURISTIDÆ

- A. Smaller species, total length less than 500 mm.
- a. Ears without prominent basal tufts, pm⁴ not enlarged. *Pteromys*
 - a'. Bullæ well inflated, molar ridges high.
 - a''. Mammæ eight. Subgenus *Pteromys*
 - b''. Mammæ six. Subgenus *Hylopetes*
 - b'. Bullæ low, little inflated; molar ridges lower with supplementary cusps externally between the transverse ridges. . . Subgenus *Petinomys*
 - b. Ears with prominent basal tufts; pm⁴ enlarged, its enamel pattern complex. *Belomys*
- B. Larger species, total length exceeding 500 mm.
- a. Ears without basal tufts of elongate hairs; pm⁴ subequal in crown area to m¹, not hiding pm³ in side view.
 - a'. Upper incisors narrow, ungrooved, molars subequal. *Petaurista*
 - b'. Upper incisors broad, with a vertical groove, m³ smaller in crown area than the others. *Aëretes*
 - b. Ears with prominent basal tufts of long soft hairs; pm⁴ very large, exceeding m¹, and hiding pm³ in side view, the enamel pattern complex. *Trogopterus*

Genus *Pteromys* G. Cuvier

FLYING SQUIRRELS

Pteromys G. Cuvier, Leçons Anat. Comp., vol. 1, tabl. 1, 1800 (type *Sciurus volans* Linn.; see Miller, Proc. Biol. Soc. Washington, vol. 27, p. 216, 1914).

Sciurus Linnæus, Syst. Nat., ed. 10, vol. 1, p. 64, 1758 (in part, *Sciurus volans*, not *Mus volans* which becomes *Glaucomys volans*).

Sciuropterus F. Cuvier, Dents des Mammifères, p. 255, 1825 (type *Sciurus volans* Linn.). Miller, Cat. Mamm. Western Europe, p. 941, 1912.

The genus *Pteromys* as now restricted takes the place of *Sciuropterus* and has as its type the species *P. volans* with its geographic races, characteristic of the boreal evergreen forests of the Old World from Scandinavia to eastern Siberia. Its characters have been given in minute detail by Miller (1912). Compared with *Sciurus* there are many minor cranial differences, among the more obvious of which are the enlarged orbits, the deep notch at the front of the postorbital processes, the deep concavity between orbits, the presence of a nearly vertical ridge-like projection in the middle of the temporal fossa, and the enlarged bullæ, whose lengthwise diameter equals the distance from their anterior edge to the front of the first molar. The lower jaw has a rather broader angular portion. The teeth are the same in number as in *Sciurus*, namely: $i. \frac{1}{1}$ $c. \frac{0}{0}$ $pm. \frac{2}{1}$ $m. \frac{3}{3} = 22$. The anterior upper premolar is very small, but in the tooth row, while the second is much larger, with about the same crown area as the first molar. The molariform teeth are somewhat similar to those of *Sciurus*, but the anterior transverse ledge forming the front border of the molars is raised to form a ridge about as high as the two main

transverse ridges. On the large upper premolar and the two succeeding molars the posterior transverse ridge has a slight indentation on its hinder margin that cuts off a distinct internal cusp. On the lingual side of these teeth there are two vertical grooves dividing the inner face into three indistinct portions, while opposite the anterior of these two grooves an inward projection of enamel forms a small cusp in the valley between the first and second of the transverse ridges. The lower teeth are essentially like those of *Sciurus*, but have the minute folds and cusplets slightly better developed. Typical *Pteromys* has eight mammæ, two pairs pectoral, two inguinal. In his review of the classification of the flying squirrels, Pocock (1923) describes and figures the penis and baculum of *Hylapetes*, but these parts in *Pteromys* remain to be studied.

Thomas (1908) proposed to subdivide the old genus "*Sciuropterus*" (= *Pteromys*) into several subgenera, based on minor characters. He showed that the New World species constitute a separate group, and that the various small species of eastern Asia fall into a number of other distinguishable types, all of which were given subgeneric standing. While current usage is to regard these as distinct genera, perhaps the most convenient way of expressing these divergences is to retain them as subgenera until the anatomical characters, and especially those of the penis and baculum, can be studied.

The two following races of typical *Pteromys* have been described from the fir forests of northern China. The other Chinese subgenera are subtropical, thus further emphasizing the distinction of the groups.

306. *Pteromys volans buechneri* (Satunin)

Sciuropterus buechneri Satunin, Annuaire Mus. Zool. Acad. Imp. Sci., St. Pétersbourg, vol. 7, p. 549, 1902.
Pteromys volans Buechner, Wiss. Resultate d. v. Przewalski Reisen, vol. 1, Säugethiere, p. 1, 1888.

Type specimens.—In describing this flying squirrel, Satunin had before him seven males and three females, skins and skulls, from the vicinity of the temple "Tschortentan" in Kansu, China, collected by Kozlov, as well as a single one from the same place collected by Przewalski in June, 1872. Since no one is mentioned as the type, all are cotypes, and presumably are still in the collection of the Zoological Museum of the Academy of Sciences at Leningrad.

Description.—Satunin describes the color as follows: in summer coat much darker than specimens from eastern Siberia, the tail especially darker, almost blackish brown instead of pale yellowish brown washed with gray. In winter skins the entire upper side is a beautiful pale rusty brown, finely lined with black through which the slaty bases of the hairs show. The individual hairs of the back are slaty black at base, then with a ring of pale reddish brown, and a black tip. The reddish shade may vary to an almost rusty brown. Cheeks and lips white, a narrow black eye-ring; vibrissæ black. Ears pale brown,

sparsely haired except at the rims. On the lower side of the body the hairs are light smoke-gray at base, tipped with white. The tail above and below is mostly blackish brown, with the sides proximally pale yellow to orange. A postauricular patch may be present, varying in color from paler to more rusty. Soles of fore feet and distal part of those of the hind feet bare; claws whitish.

Measurements:—Satunin and Buechner have published the following measurements: head and body, 186, 156, 198 mm.; tail, —, —, 100; hind foot, 33, 33, 35; ear, 16, 15,— (the first two measurements in each case from Satunin, the third from Buechner).

Two skulls of Satunin's series measured as follows: greatest (occipital) length, 40, 40 mm.; basilar length, 31, 32; zygomatic width, 23, 23; mastoid width, 19, 19; upper tooth row, 7.2, 7.2; lower tooth row, 7.1, 7.6.

Occurrence and Habits:—On his exploration into Kansu in 1872, Przewalski obtained a specimen in the forest near the temple "Tschortentan," where later Kozlov obtained a winter series. Although this form appears to be not uncommon here, Przewalski found it difficult to secure. Elsewhere in China the only naturalist who has found these squirrels seems to be Sowerby (1923g). He writes that he collected a number of specimens in western Shansi, which at first he thought to represent an unnamed race, but finally concluded that they were identical with the race *buechneri*. He saw but failed to secure a flying squirrel, believed to be of this genus, in the mountains of southern Shansi as well. Further, he reports having seen living specimens and dried skins of a "*Sciuropterus*" from the Tungling in Hopei, but possibly these were of the following race. The Shansi specimens mentioned included nine from the mountains ten miles south of Wutsai at 8,000 feet, and a tenth from about the same locality received from a native hunter (Sowerby, 1918, p. 189). Six of this series were taken in a hollow tree, and all nine are now in the collection of the U. S. National Museum (A. B. Howell, 1929, p. 48). According to native hunters, they feed on nuts and pine seeds. No doubt owls and the smaller cats frequently capture these squirrels at night, for Przewalski states that during a winter's hunt in the forests about Tschortentan in February, 1884, he picked up the tails of more than ten, that doubtless had been dropped after the captors had eaten the bodies.

Specimens examined:—None.

307. *Pteromys volans wulungshanensis* (Mori)

JEHOL FLYING SQUIRREL

Sciuropterus wulungshanensis Mori, Rept. First Sci. Exped. to Manchoukuo, sect. 5, div. 2, pt. 4, p. 59 (English), pls. 5, 6, text figs. 7, 8, March, 1939.

Type specimen:—An adult male skin (in alcohol), and skull, from Mt.

Wuling (Wulung), Hsinglunghsien, southern Jehol, September 1, 1933. The location of the type is not clear.

Description.—According to its describer this flying squirrel is much smaller and darker than *P. v. buechneri* and the European race, but the dimensions given do not bear this out, nor are the feet shorter as he states. The upper parts are described as uniform buckthorn brown, blackish slate basally; upper surface of hands and feet ochraceous buff; crown brown, cheeks paler; a narrow blackish eye-ring; under parts and inside of limbs white with a faint buffy cast; tail warm buff above, light buff mixed with white below.

Measurements.—Mori gives the following measurements of the type: head and body, 159 mm.; tail, 117; hind foot, 35; ear, 18. Skull: greatest length, 41 mm.; basilar length, 31; zygomatic width, 25; length of nasals, 13; interorbital constriction, 8; length of palate, 20; width of brain case, 18; maxillary cheek teeth, 8.

Occurrence and Habits.—While this race, as described, does not seem very different from *P. v. buechneri*, it may stand for the present until series of the two can be compared. Probably the small flying squirrels mentioned by Sowerby from the Tungling in Hopei should be of this race.

Specimens examined.—None.

Subgenus *Hylopetes* Thomas

Hylopetes Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 1, p. 6, 1908 (as a subgenus); *ibid.*, ser. 9, vol. 11, p. 658, 1923 (as a genus).

Sciuropterus of authors (in part).

In subdividing the old genus *Pteromys* (or "*Sciuropterus*") in 1908, Thomas proposed to recognize four and later five subgenera, typical *Pteromys* and *Glaucomys* of North America, and *Eoglaucomys*, *Hylopetes*, and *Petinomys* of southeastern Asia. *Glaucomys* is regarded now as a full genus, and Thomas himself later gave the same rank to *Hylopetes*, which seems to be the logical course if *Glaucomys* is to be similarly elevated. No doubt the subgroups are closely related, more so, probably, than to *Belomys*. The teeth of *Hylopetes* are like those of *Glaucomys* in essential structure, with transverse ridges of the upper molars complete, and partly joined internally to the outer slope of the internal wall, and lacking any notch extending part way across the tooth from the inner side. There is, however, an increased tendency of the enamel to be finely sculptured between and on the sides of the ridges. The bullæ are well inflated, sometimes doubled by the swelling up of the posterior mastoid portion. The mammæ are six (Thomas). The baculum in *H. alboniger* has been figured and described by Pocock (1923, p. 244), who finds it very similar in form to that

of a species of *Petinomys*, in having a rather long sigmoid outline in side view, with an upturned tapering point and a wide thin wing-like expansion on the left terminal half, ending posteriorly in a sharp backwardly produced angle. Seen from below there is a sweeping curve to the left, then to the right, again giving a long S-shape to the structure. In *Petinomys* the bone is shorter but essentially similar. Type species of *Hylopetes*, *Sciuropterus everetti* Thomas. A single species occurs in southwestern China.

308. *Pteromys* (*Hylopetes*) *alboniger orinus* subsp. nov.

BLACK-AND-WHITE FLYING SQUIRREL

Pteromys alboniger Anderson, Anat. and Zool. Researches Western Yunnan, p. 298, 1879.

Hylopetes alboniger Thomas, Ann. Mag. Nat. Hist., ser. 9, vol. 11, p. 658, 1923.

Pteromys (*Hylopetes*) *alboniger* G. M. Allen, Amer. Mus. Novitates, no. 163, p. 15, 1925.

Type specimen.—An adult female, skin and skull, No. 28086, Museum of Comparative Zoölogy, from the Likiang Range, at about 7,800 feet altitude, Yunnan, China. Collected December, 1931, by Dr. Joseph F. Rock.

Description.—Size large for the *Pteromys* group, the forehead, top of head, nape, and back consisting of soft hairs of a dark slaty for most of their length, with a minute tip of dull buffy or pale drab, giving a generally drab color to the entire upper surface, darkened by the showing through of the blackish bases of the fur. At the anterior edge of the forearm the tips of the hairs become paler, almost white. The outer edge of the membrane above is black from wrist to hip, narrowly edged with white for about thirty millimeters back from the wrist. Ears clothed with minute black hairs within and without. Hands and feet dark gray, the hind toes white. Under surface of body and membranes white with a slight drab tint on the belly; the hairs of the chin and throat and in the axil of the arms white to the base, but elsewhere with dark blue-gray bases. Tail soft and full-haired, only slightly flattened dorso-ventrally; pale smoky gray above, overlain with long black tips to the hairs, so that it looks pale at the extreme base and sides, but black above and all around at the tip; the basal half below is buffy gray at the sides, slightly darker in the center, the terminal half black.

The typical subspecies, *P. alboniger alboniger*, was described from Nepal by Hodgson (Journ. Asiatic Soc. Bengal, vol. 5, p. 321, 1836) and I have had the privilege of examining the two cotypes and a third specimen with better skull, now in the collection of the British Museum, and of comparing with Likiang specimens. The latter prove to be uniformly and markedly larger, with larger teeth and audital bullæ, with the terminal three-quarters or more of the tail black instead of brown with black, while the basal part of the tail is

grayer. The feet are larger by several millimeters. In specimens from Nepal they range (without claws) from 36.5-39.3 mm. in five specimens, against 40.5-45 in those from Likiang.

Measurements.—The only available flesh measurements are those accompanying the series in the British Museum, namely:

No.	Head and body	Tail	Hind foot	Ear	Locality
23.4.1.30 BM	203	182	40.5 (s.u.)	31	Yunnan
23.4.1.97 BM	—	—	44.0 (s.u.)	31	Yunnan
23.4.1.94 BM	—	—	45.0 (s.u.)	34	Yunnan
23.4.1.95 BM	—	—	42.0 (s.u.)	30	Yunnan
23.4.1.96 BM	—	—	44.0 (s.u.)	33	Yunnan

In the cranial measurements that follow, I have included for comparison those of the cotypes of *P. alboniger alboniger* from Nepal.

CRANIAL MEASUREMENTS OF *PTEROMYS (HYLOPETES)*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
<i>P. alboniger orinus</i>									
28087 MCZ	48.6	—	25.3	31.2	23.6	12.6	10.0	10.5	Yunnan
28086 MCZ (type)	49.0	—	25.5	30.5	22.6	12.6	10.4	10.2	Yunnan
23.4.1.30 BM	50.3	43.1	26.7	31.8	24.8	13.6	11.3	10.7	Yunnan
23.4.1.31 BM	49.3	40.7	25.8	29.7	23.5	12.7	10.7	10.3	Yunnan
23.4.1.97 BM	51.0	43.8	26.8	32.2	25.5	13.0	10.2	10.2	Yunnan
23.4.1.94 BM	47.4	39.3	24.3	28.5	23.7	13.3	11.1	11.3	Yunnan
<i>P. alboniger alboniger</i>									
43.1.12.49 BM (cotype)	46.5	—	23.8	27.5	—	11.7	9.5	8.8	Nepal
43.1.12.50 BM (cotype)	47.4	—	25.7	29.8	—	(12.6)	10.5	9.7	Nepal
86.7.2.4 BM	47.7	—	25.0	29.1	23.2	12.7	9.5	9.4	Nepal

Occurrence and Habits.—This dark-colored species ranges from Nepal eastward into the mountain forests of southwestern Yunnan, but those of the latter are considerably larger in tooth and foot than the typical race of Nepal. As long ago as 1879, J. Anderson recorded this flying squirrel from Tengyueh, where he secured skins, probably from native hunters. Dr. R. C. Andrews secured similar skins from hunters at Wutinghsien and Likiang, while Thomas (1923) records two collected by Forrest on the northwest flank of the Likiang Range at an elevation of 11,000 feet. Two specimens in the Museum of Comparative Zoölogy were obtained by Dr. J. F. Rock on the Snow Range, Likiang, by shooting the animals at night as they were feeding in an oak tree to which

they were probably attracted by the acorns. From the same tree were shot specimens of *Petaurista alborufus ochraspis* and *Trogopterus x. edithæ*. Forrest found his in mixed forest.

Specimens examined:—In all, eleven, as follows:

Yunnan: Wutinghsien, 2; Likiang Range, 3 (A.M.N.H.), 2 (M.C.Z.), 4 (B.M.).

Subgenus **Petinomys** Thomas

Petinomys Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 1, p. 6, 1908.

These are small, rather dark-colored flying squirrels with markedly distichous tails, and having four to six mammae instead of eight, the number found in typical *Pteromys*. The principal distinctions in the teeth and skull are pointed out by Thomas, essentially as follows: teeth with rather lower cusps and ridges than in typical *Pteromys*, the enamel rather more elaborately sculptured and with a more frequent development of small accessory cusps, especially at the outer exit of the valley between the main transverse ridges of upper molars 1 and 2. Skull broad and low, with a short muzzle. Bullae fairly large, but peculiarly low and flattened, scarcely rising above the level of the base of the skull, thick and opaque.

The group ranges from southern India and Ceylon to the Malay Peninsula and extreme southern China, and so is essentially tropical, in contrast to the boreal *Pteromys*. At present it is known in China only from the island of Hainan, where the following species was discovered by Mr. Clifford H. Pope in 1923.

309. ***Pteromys electilis*** G. M. Allen

HAINAN FLYING SQUIRREL

Pteromys (Petinomys) electilis G. M. Allen, Amer. Mus. Novitates, no. 163, p. 16, 1925.

Type specimen:—An adult female, skin and skull, No. 58177, American Museum of Natural History, from Namfong, island of Hainan, China. Collected by Clifford H. Pope of the Central Asiatic Expeditions in April, 1923.

Description:—A rather small species, with pale russet back, grading into fuscous on the upper part of the membrane. The dorsal surface from nose to base of tail uniform pale cinnamon, the basal four-fifths of the hairs fuscous. On the limbs and flanks the tips of the hairs are pale, grayish or whitish, but these contrasted tips disappear on the edge of the flying membrane, which is blackish brown with a narrow white edging, most prominent along the posterior half but passing more to the ventral side in the anterior half. Backs of the feet covered with short hairs, whitish and fuscous, the latter predominating on the hind feet; terminal half or more of the hind toes white. Side of the head from eye to ear dusky, below which the white of the lips is continued backward

and upward, forming a white streak behind the ear on each side of the upper neck. A narrow dusky ring surrounds the eye. Below, the chin, throat and upper arm are pure white to the bases of the hairs, which elsewhere have slaty bases, those of the membrane paler. Along the flanks a wash of cinnamon extends from axilla to knee. The distichous tail is broadest at about its basal third, whence it tapers regularly to the tip. It is slightly darker than the back, pale cinnamon washed with dusky, the latter tint deepening toward the end to produce a distinctly marked tip. Ears naked.

There is a certain amount of individual variation perceptible in the series, some having the parachute membrane rusty instead of fuscous, and the tail may be less cinnamon. In some, the pure white areas of throat and axilla may be continuous and extend as a narrow line down the center of the chest, or there may be a pure-white area at the groin. Immature examples are grayer above than adults through the prevalence of white-tipped hairs.

Measurements.—The dimensions of a series of topotypes, as recorded by the collector, are as follows:

No.	Head and body	Tail	Hind foot	Ear	Locality
58161	165	145	35	27	Hainan
58162	169	135	34	27	Hainan
58166	168	140	32	25	Hainan
58168	173	145	34	23	Hainan
58171	168	140	34	26	Hainan
58172	163	151	34	25	Hainan
58174	163	142	32	26	Hainan
58177 (type)	172	159	35	26	Hainan
58198	165	141	32	27	Hainan
58199	168	140	33	25	Hainan

The skull shows the short rostrum and low, uninflated bullæ typical of this group. The cheek teeth are roughened on their crowns and have a small lateral cusplet at the outer entrance of the transverse valleys of the anterior upper molars. The dimensions of skulls follow.

CRANIAL MEASUREMENTS OF *PTEROMYS ELECTILIS*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
58165	39.0	32.2	20.5	23.3	18.5	9.7	7.8	7.5	Hainan
58170	36.4	30.5	18.7	21.5	19.0	9.8	7.7	7.3	Hainan
58173	40.0	33.0	20.2	24.5	20.2	10.1	7.6	7.9	Hainan
58174	38.9	32.5	20.4	23.3	18.7	9.7	7.6	7.4	Hainan
58187	37.6	31.0	19.1	23.0	18.8	9.7	8.0	7.5	Hainan
58191	37.0	31.5	19.5	23.0	18.8	9.9	7.8	7.5	Hainan
58177 (type)	41.5	35.0	21.7	25.0	18.7	—	8.0	7.6	Hainan

Occurrence and Habits:—So far as at present known, this flying squirrel is found only in the forests of Hainan where, at Namfong, Mr. Clifford H. Pope secured a large series in March and April, 1923. No doubt it will eventually be found in other parts of the island, and perhaps on the neighboring mainland, as with so many other Hainan species. At present, however, no close relative is known from other parts of China. Curiously, Swinhoe, with much experience of Hainan mammals, had no knowledge of it, and it remained for Mr. Pope to discover it at this later date. He writes that "many of these were shot by the Miaos along with the big species [*Petaurista*]. The Loi aborigines also brought out a lot. We once bought nineteen at once [perhaps secured from a winter aggregation]. One would say that the little squirrels are quite common in the big woods, but they do not venture out to inhabit jungle patches north of the central mountains."

Specimens examined:—A total of forty-two from Namfong, Hainan.

Genus *Belomys* Thomas

TUFTED FLYING SQUIRRELS

Belomys Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 1, p. 2, 1908.

Sciuropterus of authors, in part.

The flying squirrels of this genus are distinguished externally from *Pteromys* by the presence of a tuft of long delicate hair at the base of each ear, while the ears themselves are large. The chief distinctions lie in the structure of the teeth, as pointed out by Thomas. The upper cheek teeth are exceedingly complicated, as in *Trogopterus*, but their crowns are lower, and the large premolar is of proportionally less size, scarcely exceeding the first molar in crown area. The essential pattern of the molars is much as in *Pteromys*, but the ridges are deeply grooved, wrinkled and excavated. Not only is the postero-internal cusp of each tooth separated from the main part of the inner longitudinal ridge, but the anterior end of this ridge is cut off by another deep notch from the middle part, so that the inner border of the two anterior molars shows from the inner aspect three cusps, a small anterior, a large middle, and a fairly developed posterior. Externally, at the exit of the middle valley is a well-marked projecting angle, deeply grooved down its center, forming a projecting gutter. The small anterior premolar (pm³) is comparatively large, and lies internal to the front cusp of the large premolar (pm⁴).

The baculum, figured in *B. trichotis* by Pocock (1923, p. 245), is peculiarly short and broad, roughly rectangular as seen from above, with a short curved hook near the tip on the left-hand side, recalling that in *Petaurista*, but shorter.

The type species is *Belomys pearsonii* (Gray) of Darjeeling, the range of which just reaches southern China.

310. *Belomys pearsonii pearsonii* (Gray)

PEARSON'S FLYING SQUIRREL

Sciuropterus *pearsonii* Gray, Ann. Mag. Nat. Hist., ser. 1, vol. 10, p. 263, 1842.

Pteromys pearsonii Anderson, Anat. and Zool. Researches Western Yunnan, p. 293, pl. 23 (colored), 1879.

Belomys pearsoni Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 1, p. 2, 1908.

?*Belomys trichotis* Robinson and Kloss, Records Indian Mus., vol. 15, p. 179, 1918.

Type specimen.—The type specimen was sent to J. E. Gray from Darjeeling, India, by his friend Pearson, and although said by Anderson (1879) to be in the Indian Museum at Calcutta, where he examined it, Robinson and Kloss (1918) failed to find it there and suppose it is at the British Museum.

Description.—The species is figured in color by Anderson (see above reference), who describes it as follows: "a small flying squirrel about the size of *P. alboniger*, but considerably more rufous than that species, and at once distinguished from it . . . by the long hairs that clothe the base of the ears . . . The upper surface of the head, and the back are rich glossy reddish-brown, finely grizzled with black; the parachute being blackish-brown, faintly and sparsely washed with reddish-brown. The fur is very fine, soft and rather long, but adpressed, and the hidden portion is almost black, narrowly tipped with reddish-brown, the sides of the hair being blackish-brown . . . On the parachute, only a few hairs have the reddish band, and these are most numerous towards the margin. The tail is rather bushy and but slightly distichous, and the hidden portion of its fur is pale fawn at the base, passing into pale chestnut-brown, washed with dusky-brown on the sides and upper surface. The margins of the eyelids are dark brown, and the sides of the face are pale rufous. The ears are moderately large and rounded, rather dark brown towards the tips, and pencilled at the base, anteriorly and posteriorly with long delicate hairs. There are no true cheek-bristles, but the moustachial hairs are very long. The under surface is pale ferruginous, palest on the mesial line, and most rufescent on the outer half of the membrane, the margin of which inferiorly is pale-yellowish . . ."

Measurements.—According to Anderson, the head and body measure about 8 inches (250 mm.), the tail about 4 inches (125 mm.).

No cranial measurements are available.

Occurrence and Habits.—This tufted-eared squirrel ranges from Nepal eastward into southern China and is represented in the island of Formosa by a closely allied form, *B. kaleensis*. It would therefore be expected to occur in the southern provinces, but hitherto very little has been discovered as to its presence. Anderson (1879) records that he secured two specimens at Tengyueh in southwestern Yunnan, and that he was unable to perceive any essential difference between these specimens and the type of *B. kaleensis*, although, of

course, at that time minute distinctions were carried less far than at present. According to Robinson and Kloss (1918, p. 179), these two specimens now consist of a skull and the two skins, which they doubtfully refer to *B. trichotis* because the teeth seem larger in the single skull than in specimens of typical *B. p. pearsonii*. Possibly the Yunnan animal is subspecifically distinct. No further examples seem to have been taken by the various collectors who have visited Yunnan. Shih (1930, p. 5), however, has more recently recorded it from the Yao Shan area of Kwangtung, so that its distribution across southern China seems to be fairly certain. A slightly smaller race has lately been described by Osgood (1932) from south of Lai Chau, Tongking.

Specimens examined:—None.

Genus **Petaurista** Link

GIANT FLYING SQUIRRELS

Petaurista Link, Beyträge z. Naturgesch., vol. 1, pt. 2, pp. 52, 78, 1795.

As originally proposed, this genus included various smaller species of what is now *Pteromys*, which, having been eliminated, leaves as the type of the genus, *Petaurista taguan* = *Petaurista petaurista* (Gmelin). Compared with *Pteromys*, these are giant forms, for the most part with long cylindrical tails instead of distichous, although in some of the smaller members of the group the tail is somewhat flattened. The skeleton is light, with long, slender limb bones, and in some of the species, at least, there is a distinct entepicondylar foramen at the distal end of the humerus, a primitive character not found in most rodents. The fibula of the hind leg is very slender but complete, while the bones of the forearm are also extremely slender. As in *Pteromys*, there is developed at the wrist a long rod that becomes more or less bony and serves to spread the anterior edge of the lateral parachute or membrane. The skull closely resembles in general contour that of the genus *Pteromys*, but is proportionally larger and heavier, with the interorbital depression well marked. There is also a greater tendency for the bones of the cranium to fuse early, obliterating the median suture of the frontals and parietals, while the interparietals unite with the parietals so thoroughly that they do not appear at all as a distinct element, although their combined posterior edge forms a suture at its union with the supraoccipital. The teeth are the same in number as in the smaller genus, but differ in details. The small upper premolar is situated in the middle of the front border of the large premolar. This latter is of about the same size as the two succeeding molars in crown area, but the last upper molar is distinctly the smallest of the upper cheek teeth, and the first lower tooth is the smallest of the mandibular teeth, of which the three molars are subequal. The upper molariform teeth differ notably from those of *Pteromys*,

first, in that each has two transverse enamel ridges, whereas in *Pteromys* the last molar has the anterior ridge only; and second, each of these teeth has two conspicuous reëntrant angles, one at the postero-internal corner of the tooth and one near the middle of the posterior border. The former is the deeper, and is clearly visible, even in much worn teeth, while the latter is of less vertical extent, and with medium wear disappears, but its internal portion is represented by a rounded island of enamel within the posterior wall of the tooth. Each of the upper molars has a small enamel fold projecting forward from the inner part of the anterior transverse ridge. In the lower molars these reëntrants are reversed and there is a deep notch on the antero-external corner and a shallower one on the front edge of each tooth near the middle. Laterally there is a deep W-shaped indentation in the middle of each of the large teeth.

Of the various species included within this genus, by far the handsomest are the chestnut and maroon *Petaurista alborufus* and *P. yunanensis*, and the bright rufous *P. petaurista rufipes*. Perhaps eventually the genus will be split into subgenera to emphasize the intergroup relations, as with *Pteromys*, for there are obviously various degrees of kinship. A comparative study of the anatomy of these squirrels is much needed, especially an account of the genitalia. The following key is based on the Chinese species only, of which there are at least half a dozen, with a distribution area covering the wooded parts of the southern half of the country. To this list may eventually be added *Petaurista sybilla*, recorded by Thomas (1921a, p. 501) from the "Burmo-Chinese Frontier."

KEY TO THE CHINESE SPECIES OF *Petaurista*

- A. Color nearly uniform rufous.
 - a. Color uniform rufous above..... *P. petaurista rufipes*
 - b. Darker, tail tip black..... *P. p. rubicundus*
- B. Color not uniform rufous.
 - a. Shoulders and membranes chiefly deep maroon.
 - a'. Lower back with a large pale patch.
 - a''. Feet reddish.
 - 1. Pale patch tinged with buff..... *P. alborufus alborufus*
 - 2. Dorsal patch paler..... *P. a. ochraspis*
 - b''. Feet black..... *P. a. castaneus*
 - b'. Back maroon with scattered pale-tipped hairs..... *P. yunanensis*
 - b. Shoulders and membranes not maroon.
 - a'. Head blackish, back dark.
 - a''. Nearly uniform black overlain with tawny above..... *P. hainanus*
 - b''. Head and back with many pure white spots..... *P. punctatus marica*
 - b'. Head and body gray, grizzled with paler.
 - a''. Spot at inner base of ear pale ochraceous, feet black... *P. xanthotis*
 - b''. Spot at inner base of ear more rusty, feet ochraceous rufous..... *P. clarkei*

311. *Petaurista petaurista rufipes* G. M. Allen

RUFIOUS FLYING SQUIRREL

Petaurista petaurista rufipes G. M. Allen, Amer. Mus. Novitates, no. 163, p. 13, 1925.

?*Pterormys yunnanesis* (sic) Shih, Bull. Dept. Biol., Sun Yatsen Univ., Canton, no. 4, p. 5, 1930.

Type specimen:—An adult male, skin only, No. 58224, American Museum of Natural History, from Yungan, Fukien, China. Collected by Rev. H. R. Caldwell, September 26, 1921.

Description:—A wholly "red" species. The entire dorsal surface of the body, including the backs of the feet, the fingers and entire tail, a rich "tawny" or ferruginous, glossy; the ends of some of the hairs of the nape and mid-dorsal area minutely tipped with black, which causes a slight darkening. Vibrissæ and a narrow eye-ring black. A minute dull-brown spot at the chin. Entire lower surface of the body pinkish rufous, nearly "ochraceous salmon," deepening to "tawny" at the outer border of the membrane.

Measurements:—No flesh measurements are available, but the type skin as made up measures approximately: head and body, 375 mm.; tail, 330; hind foot, 74.

Unfortunately none of the three specimens available has its skull preserved.

Occurrence and Habits:—The typical subspecies of this handsome rufous squirrel is found in Java, so that the extension of the range to eastern Fukien is an interesting discovery by Mr. Caldwell. He secured two skins at Yungan, and a third at Kweihwa, in eastern Fukien. The representative of the species in the Malay Peninsula is the race *Pteromys melanotus* of Gray, but the Fukien race seems to have no trace of black in the tail or back of adults. Probably the animal noted by Shih (1930)—"bright red above"—from the Yao Shan area, Kwangtung, "*Pterormys yunnanesis*," is this same flying squirrel. What seems to be the Szechwan representative of the same species is the following. Nothing is known of the habits of either.

Specimens examined:—Three, namely:

Fukien: Yungan, 2; Kweihwa, 1.

312. *Petaurista petaurista rubicundus* A. B. Howell

SZECHWAN RUFIOUS FLYING SQUIRREL

Petaurista rubicundus A. B. Howell, Journ. Washington Acad. Sci., vol. 17, p. 82, 1927.

Type specimen:—An adult female, skin only, No. 240857, U. S. National Museum, from Mapientung, some sixty miles northwest of Suifu, Szechwan, China. Killed by native hunters in the autumn of 1924, and secured by David C. Graham.

Description.—This is described by A. B. Howell (1927a) as a rufous squirrel with the tip of the tail black, and the back apparently slightly darker than in the eastern race of Fukien. "The underparts are palest mediad, being almost apricot color, but gradually deepening to intense rufous upon the throat and borders of the membranes. The feet are of the same color but a trifle darker. The pelage of the dorsal surface is thick and full, plumbeous at base, the shorter hairs with brown tips. The very numerous guard hairs are annulated first very dark brown, then black for one or two millimeters followed by ochraceous rufous for some ten millimeters, and finally short tips of glossy black, the latter hardly distinguishable in general effect. The ears are thin and almost hairless, and the postauricular spots are not differentiated. The hairs of the face are deep rufous with plumbeous bases and short black tips, resulting in a rich effect. The proximal portion of the tail is dull mahogany, with short black tips that gradually lengthen caudad until the tail tip is entirely black."

Measurements.—The type was unaccompanied by measurements, but the hind foot is about 72 mm., practically as in the Fukien race.

The cranial characters are as yet unknown, also.

Occurrence and Habits.—This seems to be a darker representative of the Fukien Rufous Flying Squirrel, to judge from Howell's careful description, and I have therefore ventured to enter it as a subspecies. Evidently members of this species are rare or difficult to find, for the hunters seem to obtain few. Only the type skin is known.

Specimens examined.—None.

313. *Petaurista alborufus alborufus* (Milne-Edwards)

RED-AND-WHITE FLYING SQUIRREL

Pteromys alborufus Milne-Edwards, Compt. Rend. Acad. Sci., Paris, vol. 70, p. 342, 1870; Recherches pour servir à l'Hist. Nat. des Mammifères, p. 298, pls. 45, 15A, fig. 1, 1868-74.

Pteromys alborufus (sic) *leucocephalus* Hilzheimer, Zool. Anzeiger, vol. 29, p. 298, 1905.

Pteromys alborufus leucocephalus Hilzheimer, Abh. u. Ber. Mus. f. Natur- u. Heimatk., Magdeburg, vol. 1, pp. 173, 174, 1906.

Petaurista alborufus Thomas, Proc. Zool. Soc. London, 1911, p. 689.

Petaurista alborufus alborufus Thomas, Ann. Mag. Nat. Hist., ser. 9, vol. 12, p. 171, 1923.

Type specimen.—The species is based on a single specimen, skin and skull, secured by Père Armand David in the mountains south of the principality of Muping, Szechwan, China, probably about 1869, and sent to the Paris Museum where presumably it still is. The exterior appearance and the skull were figured by Milne-Edwards.

Description.—A large, brilliantly colored species, with thick, glossy fur.

Muzzle, forehead to about the level of the ears, lower cheek, base of the ear, the chin, upper throat and sides of the neck white, which extends slightly on to the upper side of the parachute on the upper arm. On the upper surfaces of the head these white hairs have light ferruginous bases, and there is an irregular ferruginous area about the eye. The back of the nape and outer bases of the ears, the shoulder region and all the rest of the upper surface of the body except the central area of the back are maroon to bright bay, with glossy tips. Over the lower back from behind the shoulders to the base of the tail, the fur is broadly tipped with buff, many of the hairs minutely pointed with maroon, producing a pale area. The toes of the fore and hind feet are deep black. Tail full-haired, cylindrical, and glossy, its basal fourth pale "orange rufous" all around with a few whitish hairs on the under side. Distally the color becomes deep maroon to the tip, the hairs with their basal two-thirds deep black. Ventrally the entire pelage, except the whitish throat, is pale orange rufous, shading into maroon at the edges of the membrane.

The skull is of nearly maximum size for the genus, heavily formed, with the stout, triangular postorbital processes, hollowed forehead, and medially fused parietals as characteristic of the group. The ascending process of the premaxillaries reaches the level of the posterior border of the nasals, and the frontal bones are fused together in the median line. The temporal ridges are very slightly developed and do not meet in the sagittal line, but cross the parietals at about half the distance between it and the outer border of those bones. The teeth are relatively simple in structure as compared with *Trogopterus*. The first upper premolar is small and peg-like, with a crown area of about one-sixth that of the second premolar. The latter is molariform, and subequal in crown area with the two anterior molars, while the third molar is distinctly smaller. The enamel wall of each of these four teeth is thrown into two transverse ridges, in addition to the ridge forming the anterior face of the tooth. The pattern is further complicated by a deep reëtrant at the postero-internal corner of each. In the two anterior molars a small ridge of enamel projects diagonally from the anterior wall of the first main ridge at about a third of its distance from the inner wall of the tooth, but this is lacking in the last molar. The two anterior molars also have a very shallow vertical groove at about the middle of the lingual side, and a minute cusplet at the outlet of the middle valley, externally. There is the usual reëtrant at the posterior border of each tooth.

Measurements:—Milne-Edwards (1868-74, p. 300) gives as the length of head and body in the type specimen, 580 mm.; length of tail, 430. No other fresh measurements are available.

Cranial measurements of the type specimen and those of the nearly identical Yunnan race are given in the table following.

CRANIAL MEASUREMENTS OF *PETAURISTA ALBORUFUS*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width outside molars	Upper cheek teeth	Lower cheek teeth	Locality
<i>P. alborufus alborufus</i>									
PARIS (type)	78.0	—	41.0	50.0	33.2	—	20.0	—	Szechwan
<i>P. alborufus ochraspis</i>									
28602 MCZ	82.7	—	43.8	55.8	43.8	22.5	18.8	19.1	Yunnan
28603 MCZ	—	—	41.0	—	—	19.9	18.0	19.0	Yunnan
28604 MCZ	81.2	—	39.5	54.0	43.0	22.6	18.6	19.0	Yunnan
28605 MCZ	83.0	73.1	42.5	51.7	42.6	22.3	18.0	18.9	Yunnan
28606 MCZ	82.1	68.4	41.6	53.2	42.3	21.2	18.2	19.6	Yunnan
<i>P. alborufus castaneus</i>									
95.7.4.1 BM (type)	81.0	69.4	42.7	52.0	41.5	21.0	18.9	20.5	Hupeh

Nomenclature.—Matschie (1908) has shown that Hilzheimer's *Pteromys alborufus leucocephalus* from "Tibet" is really a synonym of the typical race, *Petaurista a. alborufus*, the describer having been misled by the discrepancies in dimensions, due to his specimen having been a trade skin without flesh measurements.

Thomas (1923a) has since divided the species into three races: the typical form of the mountains south of Muping in which the feet are red; a more eastern race of Hupeh with black feet and little whitish below; and a third from Yunnan with the pale dorsal area more extensive and whitish, and also with black feet. Unfortunately his comparative material was small, and there seems to be much doubt as to the constancy of any of the characters used. A series examined from Yunnan, all taken at the same locality, shows much individual variation in the amounts of black, red, or white, and although both Milne-Edwards's figure and the skin mentioned by Thomas from Paoningfu have red feet, it seems by no means certain that others from the same region may not have black feet, just as the tails in some of the Yunnan series are red and others black. Nevertheless, it may be as well to give the supposed races recognition until sufficient material is available to fix their status more definitely, although one would expect that the eastern race is hardly distinguishable.

Occurrence and Habits.—Of the typical race, the original specimen came from the mountains of central Szechwan, south of the principality of Muping. A native-made skin agreeing in its red feet with the figure of the type has been recorded by Thomas (1911e, p. 689) from Paoningfu, northeastern Szechwan. Beyond these two records, however, there are none that certainly pertain to this race. If Thomas's view is correct, it is confined to the forests of the central and eastern parts of that province. David believed it rare, and had difficulty in securing the single specimen after eight months' residence in the country

where it occurs. P. L. Sclater, however, mentions one (Proc. Zool. Soc. London, 1887, p. 559) that was received alive from an unnamed source, at the Zoological Gardens of London.

Specimens examined:—One, from Szechwan, Paoningfu (B.M.).

314. *Petaurista alborufus castaneus* Thomas

Petaurista alborufus castaneus Thomas, Ann. Mag. Nat. Hist., ser. 9, vol. 12, p. 172, 1923.

Pteromys alborufus G. M. Allen, Mem. Mus. Comp. Zool., vol. 40, p. 234, 1912.

Type specimen:—An adult male, skin and skull, No. 95.7.4.1, British Museum, from Ichang, Hupeh, China. Collected by F. W. Styan.

Description:—Thomas (1923a) distinguishes this from the typical race by its wholly black instead of red feet, a character which, in view of the frequent interchangeability of black and red, may prove to be inconstant. In other respects there seems to be little difference. Thomas states that it is of the same glossy chestnut above, with the dull-buffy dorsal patch, bright rufous below, with, however, practically no whitish, except for a few white hairs in the inguinal region. A second native-prepared skin from the same region as the type agrees in having only the throat white, but all the rest of the under surface of chest, belly and membranes pale orange rufous, the tail maroon, without mixture of black in its terminal three-quarters (specimen in the Museum of Comparative Zoölogy).

Measurements:—No measurements of the exterior are available.

The skull is apparently like that of the typical race. For its measurements, see table under *P. a. alborufus*.

Occurrence and Habits:—This eastern race, if it finally prove to be valid, is at present known only from the forested country of Hupeh in the region about Ichang on the Yangtze, and from eastern Szechwan. Thomas mentions, in addition to five Ichang specimens, another from Chungking, a considerable distance farther up the river in southern Szechwan, and the American Museum expeditions obtained two specimens from the border between the two provinces near Wanhsien. Nothing is recorded as to the habits or habitat of this squirrel.

Specimens examined:—Nine, as follows:

Hupeh: ?near Ichang, 1 (M.C.Z.); 5, including the type (B.M.).

Szechwan: Wanhsien and vicinity, 2; Chungking, 1 (B.M.).

315. *Petaurista alborufus ochraspis* Thomas

Petaurista alborufus ochraspis Thomas, Ann. Mag. Nat. Hist., ser. 9, vol. 12, p. 172, 1923.

Type specimen:—An adult male, skin (?and skull), No. 23.1.4.93, British Museum, from the northern end of the Likiang Range, Yunnan, China. Collected by George Forrest.

Description.—According to Thomas, this race differs from the typical form of central Szechwan and from its eastern representative, in having the dorsal patch paler and the under parts of the body more washed with white. It is probable that these distinctions are valid; nevertheless, there is much individual variation in color. Five skins in the Museum of Comparative Zoölogy from the Likiang Range, in contrast to the five from Ichang mentioned by Thomas as so constant in their color characters, show wide individual differences, so that no two are quite alike. The pale patch on the lower back is in all very slightly paler in its buffy tint than in one from Hupeh; the feet in all are deep black, and the same shade extends along the anterior edge of the membrane a varying distance; in one the pale ring at the base of the tail is almost white, but in the others more fulvous; in four of the five the terminal three-quarters of the tail is maroon, slightly darkened by the black bases of the hairs showing through, but in one the entire terminal portion is deep, shining black. On the lower side of the body and membrane, one specimen is like the eastern races in being almost uniformly pale orange-rufous, becoming more brilliant at the borders of the membrane, and with only a few scattered white hairs medially and the scrotum white; the others show all intermediate conditions to the condition in which the entire ventral surfaces are white to the roots of the hair. In all, the white of the sides of the neck is continued on to the dorsal side of the membrane at the shoulder.

Measurements.—No flesh measurements are available. The hind foot in the dried skins measures about 78 mm.

For cranial measurements, see the table under the typical race.

Occurrence and Habits.—This race seems to average paler than the typical one to the north, with more extensive white areas on the lower side, although the series at hand shows considerable variation in this respect, as already indicated. Until larger series of each are available for comparison, however, its validity may well be questioned. Hitherto it has been found only on the Likiang Range of northwestern Yunnan, whence came the type and a hunter's skin, the latter brought back by the American Museum Asiatic Expeditions. In November and December, 1931, Dr. Joseph F. Rock secured for the Museum of Comparative Zoölogy the series of five from the western slopes of the Likiang snow range, the color variation of which is described above. These apparently lived in recesses of a limestone cliff, whence they would sally forth after dark. They were all shot from the same oak tree to which they would "fly" on leaving their retreat, attracted evidently by the crop of acorns. From the same tree were secured at this time two other species of flying squirrels, *Pteromys alboniger orinus* and *Trogopterus x. edithæ*. This is a species less com-

PLATE X



A White-backed Flying Squirrel (*Petaurista alborufus ochraspis*) with feet spread to show the parachute membrane. Killed at Likiang, Yunnan. Photograph by Dr. Joseph F. Rock

monly obtained by hunters, judging by the experience of those who have sought it. Apparently it is represented on the island of Formosa by *Petaurista lena*, which is all maroon except the white fore part of the head dorsally.

Specimens examined:—Seven, as follows:

Yunnan: Likiang, 1 (A.M.N.H.); west slope of Likiang Range, 5 (M.C.Z.); north end of Likiang Range, 1, the type (B.M.).

316. *Petaurista yunnanensis* (Anderson)

Pteromys yunnanensis Anderson, Ann. Mag. Nat. Hist., ser. 4, vol. 16, p. 282, 1875.

Pteromys yunnanensis Anderson, Anat. and Zool. Researches Western Yunnan, p. 282, pl. 22 (col.), 1879.

Petaurista yunnanensis Robinson and Kloss, Records Indian Mus., vol. 15, p. 173, 1918.

Type specimen:—Anderson's type is in the Indian Museum, Calcutta, a skin without skull, No. 9486, from Momein (= Tengyueh), southwestern Yunnan, China. There are three other specimens (Nos. 9725-9727) secured at the same place and time (June, 1868), of which Robinson and Kloss "think it probable that No. 9725 is at any rate the specimen figured" if not actually the type.

Description:—Fore feet and the adjacent anterior and posterior border of the parachute, the hind feet and ankles, and the terminal half or more of the tail deep lustrous black. Entire remainder of the upper parts from nose to the basal portion of the tail, rich dark maroon, the bases of the hairs everywhere slaty. Over the region from the base of the tail forward nearly to the shoulders and in a narrow line thence anteriorly in the middle of the nape, are scattered numerous hairs with a narrow subterminal ring of white and a black tip, that give a finely speckled effect to the entire lower back. "Sides of the face, below the eye and ear, are yellowish-grey, mixed with chestnut, and the chin is dusky. . . . The under surface is clad with a yellowish-white, rather woolly fur, which in some tends to a chestnut tint in the middle line, and to a darker tint of the same colour at the margin of the parachute." Ears sparsely haired, their outer side maroon along the anterior edge, black posteriorly. "The hairs on the outer side of the tarsus form a rather long and dense brush."

The skull is large but apparently shows no special peculiarities.

Measurements:—Few measurements taken in the flesh are available. Anderson (1875), however, notes the length of the head and body in skins as 24 inches (about 610 mm.), the tail the same. A skin in the collection of the American Museum bears the following dimensions on the label: head and body, 500 mm.; tail, 575; ear, 47; distance across the hind legs when spread, 700.

A skull (No. 21.12.5.44, B.M.) from the Mishmi Hills, Burma, measures: greatest length, 76.0 mm.; basal length, 65.2; palatal length, 38.5; zygomatic width, 49.1; mastoid width, 39.0; width across molars, 19.1; upper cheek teeth, 17.2; lower cheek teeth, 18.5.

Occurrence and Habits.—This very handsome maroon flying squirrel with white specklings over the back is obviously a near relative of *Petaurista alborufus* which it resembles in size and in the general deep bay coloring, the paler back of the latter corresponding to the area over which white speckling occurs in *Petaurista yunnanensis*. The two appear to be distinct species, however, with separate ranges, *P. alborufus* somewhat more northern from Szechwan and Hupeh to the mountains of the Likiang Range, *P. yunnanensis* from extreme southwestern Yunnan probably into Burma and Indo-China, although at present very little seems to be known as to the distribution beyond the fact that Anderson secured native-made skins from Tengyueh, where he was told that it was also found to the eastward in the forests of the Kananzan Mountains. Pousargues (1896a, p. 3) has recorded four specimens brought back by Prince Henri d'Orléans from Yunnan, but since no exact locality is given, it may be assumed that they were purchased in Yunnan fur markets, as were three obtained at Weisi by the American Museum Asiatic Expeditions. Two skins were also secured on April 9 and 10 at Taipingpu at 7,000 feet altitude. Howell (1929, p. 48) records two others, now in the U. S. National Museum, from Tsehchung, Yunnan, and mentions that in one the "white of the underparts is sharply differentiated from the rufous of the under border of the parachute. In the other the transition is gradual and there is a tinge of rufous over most of the underparts." So far as present evidence goes, this species is uncommon and of a somewhat restricted range in southwestern Yunnan. Nothing is known of its habits.

Specimens examined.—Seven, as follows:

Yunnan: Taipingpu, 2; Weisi, hunters' skins, purchased, 2; "western China," 3 (B.M.).

317. *Petaurista hainanus* G. M. Allen

HAINAN GIANT FLYING SQUIRREL

Petaurista hainana G. M. Allen, Amer. Mus. Novitates, no. 163, p. 15, 1925.

Type specimen.—An adult female, skin and skull, No. 58200, American Museum of Natural History, from Namfong, island of Hainan, China. Collected February 19, 1923, by Clifford H. Pope.

Description.—A large, dark species, perhaps allied to *P. philippensis*. The occiput, nape, and entire dorsal surface of the body, including the arm to the elbow, and the leg to the knee, as well as the base of the tail, are clothed with a dark brown under fur, overlain by longer hairs which are mainly black, with a wide subterminal ring of ochraceous to tawny, and a long, polished black tip. Forearm, lower leg and most of the parachute blackish brown or chestnut. The feet, anterior and posterior edges of the membrane, forearm below, and the tail all around except at the base of the upper side, deep shining black, some-

times tinged with rusty. Forehead, sides of the head, and a broad area behind each ear, along the side of the neck, shining black. Ears black, narrowly bordered with whitish. Lips white but the chin black. An area of dark-based, white-tipped hairs extends back from the lips as a narrow line below the cheeks, and turns upward to the outer base of the ear and in a broader area at the sides of the neck to the upper side of the humerus at the border of the arm. Ventral surface of the body, upper arm, and that part of the parachute from the elbow back to the middle of the tibia, white, the hairs in the median region of the body with gray bases. A narrow border at the outer edge of the parachute consists of black-tipped hairs with broad cinnamon-rufous bases showing through. These become wholly black on that portion of the membrane outside the forearm.

Measurements:—The field measurements of three specimens are:

No.	Head and body	Tail	Hind foot	Ear	Locality
58202	420	459	82	45	Hainan
58206	415	468	82	47	Hainan
58207	410	465	82	46	Hainan

In the skull the nasals extend back to the level of the ascending branches of the premaxillaries. The palate ends in a short median point instead of being evenly concave forward. The molariform teeth are subequal in size, the last molar, however, slightly smaller than the teeth anterior to it, while the first premolar is small and peg-like. All three molars and the large premolar have a short bar of enamel projecting forward from the inner part of the first transverse fold.

CRANIAL MEASUREMENTS OF *PETAURISTA HAINANUS*

No.	Greatest length	Basal length	Palatal length	Zygomastic width	Mastoid width	Width outside molars	Upper cheek teeth	Lower cheek teeth	Locality
58202	73.5	62.3	37.7	47.0	38.5	17.7	16.6	17.2	Hainan
58206	77.3	67.8	41.3	47.8	38.3	18.5	16.1	16.6	Hainan
58207	73.0	63.3	38.5	48.2	38.0	19.2	16.2	16.6	Hainan

Occurrence and Habits:—The presence of a large flying squirrel on the island of Hainan was apparently quite unknown to Swinhoe, who probably did not live near any large patches of forest that might give it shelter. It remained for Mr. Clifford H. Pope of the Central Asiatic Expeditions to secure the first specimens. He found it only in the "big woods more than fifteen miles to the south of Nodoa. There it must be abundant, for the Miao hunters shot as many as four in one day. The patches of jungle about Nodoa itself are entirely devoid of them and they do not seem to be found even in the wooded mountains eight miles to the west. Perhaps the fact that they persist at all

in country where animal life is much sought for food is due to there being no market for them at Namfong, for they have a strong odor and seem to find no favor as food." Concerning its habits no further information was secured. No doubt this flying squirrel will be found to show relationship to some form of the Indo-Chinese mainland, but at present it is not clear to what species it is most near.

Specimens examined.—Nineteen, and four extra skulls, all from the forest south of Nodda, near Namfong, Hainan.

318. *Petaurista punctatus marica* Thomas

Petaurista marica Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 9, p. 627, 1912.

Petaurista punctatus marica Robinson and Kloss, Records Indian Mus., vol. 15, p. 178, 1918.

Type specimen.—An adult male, skin and skull, from Yunnan, probably near Mengtsh, and now in the British Museum, No. 12.7.25.33. Collected by the Japanese, Orie, January 29, 1910.

Description.—This is a white-spotted flying squirrel, similar to *P. punctatus* but more yellowish in general color, with a blackish head, and bright rufous tail and feet. The head and body above are marked with a variable number of pure-white spots, each about a quarter to a half an inch in diameter, the least spotted of three specimens having about thirty, the most spotted about double that number, with the spots especially profuse on the head, but fewer than in typical *P. punctatus* of Malacca. The general color of the upper parts is otherwise of a general "tawny olive," becoming more tawny posteriorly and on the patagium, the hairs subterminally ringed with buffy or ochraceous. Anteriorly the color darkens to blackish, the ends of the hairs on the crown glossy black. Patagium tawny above, brilliant ochraceous-rufous below. The under surface of the body itself is bright ochraceous buff, with a dark brown spot on the chin. Hands irregularly marked with dark brown and deep tawny, the outer sides of the legs and upper side of the feet rich ochraceous rufous. Tail ochraceous rufous, some of the hairs ringed subterminally with blackish and buffy, the tip more or less washed with blackish.

The skull is described as resembling that of the typical race, but in the three specimens studied by Thomas showed considerable variation in outline, one having the muzzle relatively long and narrow, another having it short and broad. The postero-internal notch of the upper molars is much less well developed than in most species of *Petaurista*, so that in this respect, as well as in its rather smaller size, this species is somewhat annectant between the more typical members of the genus and the larger species of *Pteromys*.

Measurements.—The collector's measurements of the three specimens in the British Museum are as follows:

No.	Head and body	Tail	Hind foot (s.u.)	Ear	Locality
12.7.25.33 BM	365	380	63	44	Yunnan
12.7.25.34 BM	350	375	59	45	Yunnan
12.7.25.35 BM	373	347	60	45	Yunnan

CRANIAL MEASUREMENTS OF *PETAURISTA PUNCTATUS MARICA*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
12.7.25.33 BM (type)	62.5	54.1	32.2	41.8	33.4	15.9	13.3	13.2	Yunnan
12.7.25.34 BM	60.7	54.2	31.5	42.3	33.7	15.7	12.8	13.7	Yunnan
12.7.25.35 BM	61.6	54.1	32.3	40.5	31.4	14.8	13.2	13.3	Yunnan

Occurrence and Habits.—This white-spotted Flying Squirrel is evidently another tropical species that reaches the northern limits of its range in extreme southern Yunnan. The typical race is from Malacca, and this is evidently but a subspecies, as Robinson and Kloss have indicated. The three specimens secured by the Japanese collector Orii, probably near Mengtsz, in southern Yunnan, are at present the only ones to be recorded from China, but Osgood (1932, p. 268) has referred to this race a fourth from Chapa, just across the Indo-Chinese border to the southwest, and another from still farther south at Xieng Kuang in Laos. The somewhat intermediate condition of the molar pattern between that of the more typical members of the genus and that of the smaller *Pteromys* is interesting as affording a further example of the survival of annectant species in this region of Asia.

Specimens examined.—Three, the original series in the British Museum, from near Mengtsz, Yunnan.

319. *Petaurista xanthotis* (Milne-Edwards)

Pteromys xanthotis Milne-Edwards, Recherches pour servir à l'Hist. Nat. des Mammifères, p. 301, 1868-74.

Pteromys melanopterus Buechner, Bull. Acad. Imp. Sci. St. Pétersbourg, vol. 34 (new ser., vol. 2), p. 106 (Mélanges Biol., vol. 13, p. 152), 1892 (not of Milne-Edwards).

Petaurista xanthotis Lyon, Smithsonian Misc. Coll., vol. 50, p. 133, 1907.

Pteromys filchnerinæ Matschie, Wiss. Ergebn. d. Exped. Filchner nach China u. Tibet 1903-05, vol. 10, pt. 1, p. 208, 1908.

Pteromys büchneri Matschie, *ibid.*, p. 210 (not *Sciuropterus buechneri* Satunin).

Type specimen.—A mounted skin in the "galerie publique" of the Muséum d'Histoire Naturelle at Paris, sent by Père Armand David from "Tibet," that is, in all probability, Muping, Szechwan, China.

Description.—A large yellowish-gray species with an orange spot behind the ear. Muzzle, forehead, and cheeks shorter-furred than the neck and body, minutely mixed black and white, giving a gray appearance, with a faint overwash of buff, especially on the cheeks. Sides of the muzzle and lips at the base of the whiskers, white. Entire upper surface from occiput to tail a nearly

uniform buffy gray, the individual hairs of the back about 40 mm. long, the basal half slaty, becoming brownish, then forming a rather definite brownish-black band succeeded by one of equal width and buffy, with a short black tip. The tail is much the same, except that most of the hair below the blackish-brown ring is buffy. Near the edge of the membrane the hairs are blackish-basally, with rather brighter buffy tips, while the anterior half of the membrane's edge, from the wrist back along the sides, is grayish. The inner side of the ears is clothed with blackish hairs as is also the terminal half of the outer side, while the outer base shows a contrasted tuft of orange or ochraceous hairs with minute black tips. Backs of the fore feet brown, minutely mixed with paler; hind feet to the ankles, deep black above, but below, the outer furry part of the sole is contrastingly pale, nearly pale buff. Chin and throat pale gray to the base of the hairs, the rest of the under parts pale grayish white faintly washed with buff, which becomes deeper, nearly pale ochraceous, beneath the membranes.

In one specimen the extreme tip of the tail is white.

The skull shows the usual characters of the genus, with broad nasals, narrowing posteriorly, and ending with a very slight emargination on a level with the ends of the dorsal branch of the premaxillaries. There is a deep depression between the orbits; the postorbital processes are slender, triangular and very slightly notched anteriorly. The hinder end of the palate ends in a forwardly projecting even arch without a median spine. The teeth show the usual pattern. The small first upper premolar abuts against the antero-internal edge of the large premolar, but is only partly hidden by it in profile view. The molariform teeth have all essentially the same pattern, with a deep reëntrant of enamel at the postero-internal corner of each. The two anterior molars have each two, the other teeth one, vertical grooves on the inner face. The enamel foldings are finely crenulate on their inner borders. The essential enamel pattern consists of an anterior vertical ridge, and then two transverse ridges, of which the first has a short projection near its inner side connecting the anterior wall with the transverse ridge in front. As the ridges wear down the pattern becomes obscured by the cutting off of islands of enamel at different levels of wear.

Measurements:—Milne-Edwards gives the following dimensions of the type specimen, doubtless as mounted: head and body, 540 mm.; tail, 430. Buechner (1892) gives measurements of four specimens, evidently taken from the skins: head and body, 460-535 mm.; tail, 400-455, including the terminal hairs of 75 mm. length; hind foot, 70-76. These dimensions are perhaps too large, but the following taken from fresh specimens by Forrest may be considered normal.

No.	Head and body	Tail	Hind foot	Ear	Locality
23.4.1.27 BM	430	345	68 (s.u.)	50	Yunnan
23.4.1.28 BM	363	330	65 (s.u.)	43	Yunnan
23.4.1.29 BM	353	340	68	50	Yunnan

CRANIAL MEASUREMENTS OF *PETAURISTA XANTHOTIS*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width outside molars	Upper cheek teeth	Lower cheek teeth	Locality
23207 MCZ	69.8	59.0	37.6	47.0	38.0	20.9	18.0	18.9	Kansu
23907 MCZ	68.6	59.6	37.6	46.5	37.1	20.0	17.3	19.1	Kansu
23908 MCZ	69.3	61.7	37.6	46.0	37.7	20.0	15.7	17.1	Kansu
23910 MCZ	69.1	60.4	37.9	47.3	39.0	19.9	17.9	18.5	Kansu
23911 MCZ	68.5	60.7	36.6	46.0	36.1	20.0	16.1	17.0	Kansu
23.4.1.27 BM	66.0	55.9	33.7	41.9	33.3	16.6	15.3	15.1	Yunnan
23.4.1.28 BM	65.5	55.2	33.2	43.4	33.4	16.0	15.2	15.2	Yunnan
23.4.1.29 BM	66.5	57.5	34.7	43.3	34.1	18.0	16.2	15.2	Yunnan

While the Yunnan specimens measure slightly less than those from Kansu, the differences are not great and on the basis of the material seen do not warrant their separation as a distinct race.

Nomenclature.—The name *Pteromys xanthotis* was originally given by Milne-Edwards in the belief that it was, if not a distinct species, at least a variety of his *Pteromys melanopterus*, which, however, is a considerably smaller animal. Buechner (1892) later recorded other specimens from Kansu, regarding them as the same as the latter species, but his description and measurements (hind foot, 70-77 mm.) make it clear that they were not that animal, but undoubtedly represented *P. xanthotis*. Matschie (1908) perceived that Buechner's squirrel was not the same as Milne-Edwards's *P. melanopterus*, and renamed it *Pteromys büchneri* on the basis of his description. Apparently, too, Matschie's *P. filchnerinae* is either the same or else a synonym of *P. melanopterus*, for it is said to differ from the latter only in minute points of color of the anterior toes, with a slightly paler back and tail. The type was apparently a trade skin from Siningfu.

Occurrence and Habits.—In naming this squirrel Milne-Edwards supposed that it was but a variety of his *Pteromys melanopterus*, but it is clearly a distinct species of the genus *Petaurista*. The records at present available indicate that its range is extensive, from the spruce forests of northwestern Kansu southward in the highlands of western China to the Likiang region. The original specimen was doubtless from Muping in central Szechwan (then included in "Tibet"). It remained unique until 1892, when Buechner recorded seven skins brought back by Berezovski from the forests in the vicinity of Ssigu,

southern Kansu, where it was said to be known to the natives as "zui-ssyn." The fact that they were secured in winter may be evidence that the species does not hibernate. In 1907 Lyon reported a specimen sent to the U. S. National Museum from Taochow, Kansu, and the Museum of Comparative Zoölogy has since received other specimens from the same province, namely, four from Choni in the southeastern part, and another taken by Dr. J. F. Rock in the spruce forest at Babo, north slope of the north Koko Nor barrier range. Outside of these localities, Thomas (1923) has recorded two males and a female collected by Forrest on the Likiang Range at from 10,000-11,000 feet altitude. Whether these represent an isolated colony at the higher levels or whether the range is continuous from the northwestern part of China to Yunnan is still uncertain. According to the collector's note, they were taken "in mixed forest."

This squirrel must be much sought for its fur by the Chinese, for the British Museum has a trade skin from Kansu labeled "an average skin taken from a shipment of 1000"!

Nothing is recorded as to its habits.

Specimens examined:—Ten, as follows:

Kansu: Choni, 5 (M.C.Z.); Babo, Koko Nor barrier range, 1 (M.C.Z.); no definite locality, 1 (B.M.).

Yunnan: Likiang Range, 3 (B.M.).

320. *Petaurista clarkei* Thomas

Petaurista clarkei Thomas, Ann. Mag. Nat. Hist., ser. 9, vol. 10, p. 396, 1922.

Type specimen:—An adult female, skin and skull, No. 22.9.1.44, British Museum, from the Mekong valley, Yunnan, China, at about 28° north. Collected July 26, 1921, by George Forrest.

Description:—A "beautiful grey-headed species with prominent buffy patches behind the ears." The general color of the body above is mixed blackish and buffy, the hairs blackish slaty for the greater part of their length, with their tips buffy. Tail similar, its tip all black. Laterally the membranes become deep ferruginous with black bases, and on the edges of the membrane from the wrist to and including the hind feet, clear bright ferruginous. Behind each ear is a small tuft of rusty hairs. Below, the membranes are orange-rufous, the center of the body white, washed with rufous; the throat pure white.

Measurements:—The following fresh measurements are from the labels of the series in the British Museum:

No.	Head and body	Tail	Hind foot	Ear	Locality
22.9.1.44 BM (type)	320	370	65	50	Yunnan
22.9.1.41 BM	368	403	68	49	Yunnan
22.9.1.42 BM	325	365	60	46	Yunnan
22.9.1.43 BM	296	370	59	49	Yunnan
22.9.1.40 BM	315	382	60	49	Yunnan

CRANIAL MEASUREMENTS OF *PETAURISTA CLARKEI*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
22.9.1.40 BM	62.6	53.0	32.0	40.2	32.7	15.4	14.6	14.4	Yunnan
22.9.1.41 BM	63.2	—	31.8	40.8	33.3	15.8	13.8	13.7	Yunnan
22.9.1.42 BM	—	53.7	32.1	—	—	—	13.9	14.1	Yunnan
22.9.1.44 BM (type)	62.4	54.0	32.5	38.6	32.0	15.7	14.0	14.3	Yunnan
22.9.1.43 BM	64.6	—	33.4	40.5	33.6	15.8	13.7	13.8	Yunnan

Occurrence and Habits:—The gray head and the contrasting rufous hind feet distinguish this species at once, and although its range overlaps that of *P. xanthotis* in Yunnan, there is no indication that the two intergrade, so that they are evidently distinct species, notwithstanding the general similarity in size and body coloration. Almost nothing is known of the species beyond the fact of its presence in western Yunnan. The series obtained by Forrest in the Mekong valley consists of five, all shot in pine forests. In addition to these, A. B. Howell (1929) has recorded a specimen in the U. S. National Museum from Tschchung in central Yunnan, and Dr. R. C. Andrews obtained two trade skins, one in Likiang, the other in Talifu, in the same province. More recently (1934-36), Mr. Brooke Dolan secured two trade skins at Batang, on the border of Szechwan, but these may not have been taken at that place.

Specimens examined:—The following nine:

Yunnan: Likiang, 1; Talifu, 1; Mekong valley, 5 (B.M.).

Szechwan: near Batang, 2 (A.N.S.P.).

Genus *Aëretes* G. M. Allen

Aëretes G. M. Allen, Mammals of China and Mongolia (Nat. Hist. Central Asia, vol. 11, pt. 1), p. vii, September 2, 1938.

Pteromys Milne-Edwards, Ann. des Sci. Nat., Zool., ser. 5, vol. 8, p. 375, 1867 (in part); Recherches pour servir à l'Hist. Nat. des Mammifères, p. 168, 1868-74.

Petaurista G. M. Allen, Amer. Mus. Novitates, no. 163, p. 15, 1925.

This flying squirrel differs notably in the characters of the upper incisors from any known species, and merits generic distinction. The upper incisors are much broader than in any member of *Petaurista* or *Trogopterus* that I have seen, and have a well-marked groove running vertically down the outer three-quarters of the width. The rostrum is unusually short, the ascending branches

of the premaxillaries falling about two millimeters short of the proximal ends of the nasals. In most respects the molars are like those of *Petaurista*, with the small pm^3 visible from without, pm^4 not especially enlarged but, as in *Petaurista*, equaling in crown area the first molar. It differs, however, in that the anteriormost of the three ridges of the large premolar, as seen in profile, is shorter than the succeeding two instead of being equally high. In both genera there is a postero-internal reëntrant of enamel at the inner corner of each tooth, and the enamel after slight wear is considerably crinkled. The palate ends in a short median spine instead of being smoothly arched.

Externally, there is no conspicuous tuft of elongated hairs at the bases of the ears, and the tail is bushy, but distinctly distichous. The hind feet show five closely crowded pads at the base of the digits, with a long broad metatarsal pad on the inner edge of the sole which elsewhere is thickly furred. Only the single species is known.

321. *Aëretes melanopterus* (Milne-Edwards)

Pteromys melanopterus Milne-Edwards, Ann. des Sci. Nat., Zool., ser. 5, vol. 8, p. 375, 1867; Recherches pour servir à l'Hist. Nat. des Mammifères, p. 168, pls. 15, 15A, figs. 2, 2a, 2b, 1868-74.

Petaurista melanopterus G. M. Allen, Amer. Mus. Novitates, no. 163, p. 15, 1925.

Petaurista sulcatus A. B. Howell, Journ. Washington Acad. Sci., vol. 17, p. 82, 1927; Proc. U. S. Nat. Mus., vol. 75, art. 1, p. 46, 1929.

Type specimen.—The original specimen was presented to the Paris Museum by M. Fontanier, who procured it in the forests of northeastern Hopei, China, about 1867. The specimen and its skull are figured by Milne-Edwards.

Description.—A medium-sized species, smaller than most species of *Petaurista*, with a bushy flattened tail about the same length as the head and body. The entire dorsal surface of the head and body is a general mixed buffy gray and black. On parting the fur, the hair on the middle area of the head and back is seen to be slaty gray, then comes a short ring of dark brown succeeded by a conspicuous pale-buffy ring and a fine black tip. Along the sides of the body the bases of the hairs are darker, slaty, their tips more yellowish, "pale ochraceous," from the forearm region back along the membrane to the ankle. Behind the ears the black tips of the hairs are more conspicuous, forming an ill-defined black mark. The edge of the membrane is narrowly clear gray from slightly back of the wrist to the groin. Fore feet blackish brown above; wrists the same below. Hind feet with the metatarsal area, mixed black and ochraceous; the toes and sides of the foot deep black. Below, there is a blackish spot at the chin. The central area of the chest and belly is whitish, faintly washed with buffy, and at the edges of the membrane becomes clearer, pale ochraceous. The extreme bases of the hairs are every-

where slaty for a greater or less extent, but more marked on the body, less on the membranes. The tail is colored much like the back, a buffy gray, with a tendency to a narrow black border with a short buffy fringe, and a nearly clear black tip. On the under side, black predominates on the terminal half, with a considerable sprinkling of buffy hairs.

The skull characters have been mentioned in characterizing the genus. The relatively short, broad rostrum, the grooved upper incisors, the reduced size of the last upper molar are very striking, and the excess in length of the nasals over the premaxillaries is unusual.

A skeleton shows a very long lumbar region, its eight vertebræ equaling in length the combined cervical and thoracic portions of the spine. The pelvis is attached to but one sacral vertebra, to which are fused two additional vertebræ, much narrowed and nearly rod-like. The caudals number twenty-five. There are twelve pairs of ribs.

Measurements.—No fresh measurements of this flying squirrel are available except those given by A. B. Howell (1927a, p. 83) for the type of his *Petaurista sulcatus*, which appears to be the same animal: head and body, 305-310 mm.; tail, 330-343; hind foot, 63-65. The hind foot in a specimen examined measured, with claws, 63 mm.

CRANIAL MEASUREMENTS OF *AËRETES MELANOPTERUS*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width outside molars	Upper cheek teeth	Lower cheek teeth	Locality
19993 MCZ	61.5	52.0	30.8	40.3	33.8	17.8	14.1	14.3	Hopei
19994 MCZ	62.4	53.2	32.1	42.0	33.6	16.8	14.4	14.1	Hopei
45327 MCZ	60.5	52.3	30.0	40.0	32.6	17.1	12.8	13.8	Hopei

Nomenclature.—Apparently A. B. Howell (1927a) was the first to call particular attention to the grooving of the upper incisors in this flying squirrel, although the grooves are indicated in Milne-Edwards's figure of the skull. Howell refrained from making a distinct genus for the animal, however, on the ground that *Petaurista fulvinus* of Kashmir shows in some specimens evidence of faint grooves on the upper incisors. Nevertheless, since the character is so well-marked in the Hopei squirrel, and is correlated with the broadening of these teeth, the shortening of the rostrum, and the reduction in crown area of the third upper molar, it seems worthy of generic distinction, and is certainly much better set off than are the genera or subgenera of smaller flying squirrels. The name *Petaurista sulcatus* would seem to be a pure synonym of *A. melanopterus*, with the same type locality, Howell having apparently been misled by Heude's figures of skull characters. It is a question whether or not Matschie's *Pteromys filchnerinæ* is a synonym of this species or of *Petaurista xanthotis*, but an examination of the type alone would determine.

Occurrence and Habits.—So far as certain records go, this flying squirrel seems to be confined to northeastern China. The original specimen was sent by Fontanier from the mountains near Peiping, Hopei, and according to J. Anderson (1879, p. 283) the Paris Museum soon afterward received a second from the same area. Apparently but few other specimens have been recorded. Jacobi (1922) includes under *Pteromys melanopterus* two skins brought from western China, Hwanglungtze and Tieki, but these seem to have been some other species, perhaps *Petaurista xanthotis*. Dr. R. C. Andrews, however, succeeded in obtaining five specimens from the Tungling area (Eastern Tombs), Hopei, while another skin is recorded by A. B. Howell (1927a) from the same place, as well as two from Hsinlungshan, sixty-five miles northeast of Peiping. Two skins and skulls in the Museum of Comparative Zoölogy, collected by Dr. F. R. Wulsin, are also from Tungling. It would seem therefore that the forests of Hopei are, so far as certainly known, its present home.

Nothing is recorded of its habits, but its broad incisors and shortened rostrum may indicate different food habits from other related species.

Specimens examined.—In all, seven, from the Eastern Tombs, Hopei.

Genus *Trogopterus* Heude

Trogopterus Heude, Mém. concern. l'Hist. Nat. de l'Emp. Chin., vol. 4, pt. 1, p. 46, pl. 10, figs. 1-1c, 1898.

Pteromys Milne-Edwards, Ann. des Sci. Nat., Zool., ser. 5, vol. 8, p. 375, 1867 (in part); Recherches pour servir à l'Hist. Nat. des Mammifères, p. 171, 1868-74.

Externally the flying squirrels of this genus show no striking peculiarities but appear to be characterized by the presence of a small tuft of long black hair at the inner and another at the outer base of each ear; the naked metatarsal pad on the inner side of the hind foot is prominent and oval, shorter in proportion than in *Petaurista*, and more distinct from the distal pads, to which it is joined by a very narrow isthmus of naked skin. The teeth are notable for the enlargement of the posterior upper premolar (pm⁴) which exceeds in crown area any of the succeeding molar teeth which are themselves nearly subequal. The enamel pattern in all these teeth is somewhat complex and irregular, very soon wearing down into a complicated system of enamel islands and infolds. Each of the upper molars has a shallow vertical infold in the middle of the inner face, shallowest in the last molar, and in one specimen not apparent in that tooth. In the middle of the posterior edge of m¹ and m², and nearer the postero-internal corner of m³, is a much deeper reëntrant which ends anteriorly in a double lobe. A third reëntrant fold of enamel passes diagonally inward and forward from just behind the middle of the outer side, and is also bilobed. The lobes differ, however, in vertical depth, so that with even slight wear their elements tend to become broken up into isolated lakes of enamel. Of the two upper premolars, the anterior is a mere peg close against the antero-internal

face of the second, which wholly hides it when viewed from the side. The posterior premolar is the largest tooth of all, projecting inward beyond the molars. The reëntrant folds of enamel seem to be similar to those of the molars, but are more complex in the anterior part of the tooth, which in side view shows three pointed ridges, while the two first molars show but two, the third molar an anterior one only. In the lower jaw there is as usual but one premolar, but it is hypertrophied much like that of the upper jaw, in reverse fashion. The incisors are narrow as in *Petaurista*.

As originally proposed by Heude, *Trogopterus* contained two species: *Pteromys xanthipes* of China and *Sciuropterus pearsonii* of India. For the latter Thomas subsequently erected the genus *Belomys*. The type of the genus *Trogopterus* is therefore *P. xanthipes*. Several forms have been named by Thomas, of which three are Chinese, but it is probable that these are all races of a single wide-ranging species. They may be distinguished by the following key.

KEY TO THE CHINESE RACES OF *Trogopterus*

- A. General color bright ochraceous above.
 - a. Lower side whitish. *T. xanthipes xanthipes* and *T. x. mordax*
- B. General color duller, mixed with gray. *T. x. edithæ*

322. *Trogopterus xanthipes xanthipes* (Milne-Edwards)

Pteromys xanthipes Milne-Edwards, Ann. des Sci. Nat., Zool., ser. 5, vol. 8, p. 376, 1867; Recherches pour servir à l'Hist. Nat. des Mammifères, p. 171, pls. 14, 15A, figs. 3-3b, 1868-74.

Trogopterus xanthipes Heude, Mém. concern. l'Hist. Nat. de l'Emp. Chin., vol. 4, pt. 1, p. 46, pl. 10, figs. 1-1c, 1898.

Type specimen.—Milne-Edwards states that he had before him two specimens of this squirrel, but apparently only one with a skull, and even in this the teeth were so worn that the molar pattern could not be made out, while the large upper premolar, so characteristic of the genus, was lost altogether on both sides. It is not surprising, therefore, that he failed to see how different the animal is from the other genera of flying squirrels. Apparently this specimen, on which his description is based, should be regarded as a lectotype, and it is presumably in the Paris Museum, to which it was sent from the forests of northeastern Hopei, China, by M. Fontanier. It was an adult male.

Description.—This seems to be a brightly colored race, much tinted with ochraceous. Hair of the upper surface of the head and body with slaty bases tipped with bright ochraceous rufous, but among these are many all-black hairs. Muzzle and an eye-ring ochraceous-rufous, the vibrissæ black. Fore and hind feet bright fulvous above, this color extending along the front of the

propatagium, and slightly on the outer ventral border of the flying membrane. The tail is described as gray, washed with fulvous. Throat and body below whitish.

Measurements.—The following measurements published by Milne-Edwards are those of his type specimen: head and body, 300 mm.; tail, 270; hind foot, 60.

CRANIAL MEASUREMENTS OF *TROGOPTERUS*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across premaxillars	Upper cheek teeth	Lower cheek teeth	Locality
<i>T. xanthipes xanthipes</i>									
PARIS (type)	57.0	—	32.0	—	—	—	—	—	Hopei
8.8.11.61 BM	55.0	—	30.2	33.8	(26.0)	14.8	15.0	14.9	Hopei
<i>T. xanthipes edithæ</i>									
28083 MCZ	60.0	54.2	34.8	37.0	28.2	14.9	14.9	14.4	Yunnan
28084 MCZ	57.7	50.3	32.5	35.9	29.1	14.4	14.8	14.2	Yunnan
28085 MCZ	61.5	53.0	33.8	37.0	—	15.0	15.6	14.8	Yunnan
23.4.1.32 BM (type)	55.5	48.3	31.3	34.9	29.1	14.1	14.8	14.8	Yunnan
29.9.1.46 BM	55.6	46.1	30.7	32.9	27.7	14.3	14.7	15.1	Yunnan
<i>T. xanthipes mordax</i>									
95.7.5.1 BM	60.8	—	33.8	37.5	30.0	18.0	17.1	16.5	Hupei
8.8.11.62 BM	60.1	—	33.0	36.3	—	14.6	16.5	15.5	Hupei
9.7.21.4 BM	—	—	35.8	—	—	15.1	17.1	16.1	Szechwan

Occurrence and Habits.—The range of the typical race is not at all well ascertained, for specimens of this flying squirrel are rare in collections. The original two came from the mountains of Hopei near Peiping, and I have examined a third from there in the British Museum, taken in 1887. Thomas (1911e, p. 689) has recorded a single one from the Shangchow district of south-eastern Shensi, which carries the distribution well to the southwest. Nothing seems to be recorded of its habits.

Specimens examined.—One, from Peiping, Hopei (B.M.).

323. *Trogopterus xanthipes mordax* Thomas

Trogopterus mordax Thomas, Journ. Bombay Soc. Nat. Hist., vol. 23, p. 230, 1914.

Trogopterus minax Thomas, Ann. Mag. Nat. Hist., ser. 9, vol. 11, p. 658, 1923.

Type specimen.—An adult male, skin and skull, No. 95.7.5.1, British Museum, from Ichang, Hupei, China. Collected by F. W. Styan.

Description.—This is a slightly richer-colored race of the upper Yangtze region. Of the series of five in the British Museum from the type locality, the

feet are more rufous, the tails somewhat darker, the hairs of the back with deeper blackish bases and having their tips either about as in the available specimens of the typical form, grayish buff to buff, or ochraceous rufous.

Measurements:—The chief difference relied upon by Thomas in describing this race was its supposed larger size as judged by the skull and teeth. The hind foot, however, is about the same, 58 mm. in the type against 60 in the Hopei specimens. No series of external measurements is available, but they probably are hardly different from those of the typical form.

Nomenclature:—Two specimens in the British Museum from the upper Min River, Szechwan, which Thomas at first included under *T. mordax* but later decided to separate as *T. minax*, are identical in external appearance with the Ichang series. He found that the enlarged upper premolar was greater in the Min specimen with a skull, as compared with that of *T. mordax*. It seems, however, that the specimen is not fully adult and the comparison of teeth would have to be based on the unerupted premolar extracted from its capsule. It does not seem to me that the supposed differences are sufficient for a valid distinction, and I have therefore reunited the specimens under *T. x. mordax*.

Occurrence and Habits:—Specimens of this genus are rare in collections. In addition to the five from Ichang in the British Museum, and the two from the upper Min River here considered the same, no others have been recorded. There is a specimen in the collection made lately by the Brooke Dolan Expedition, that was taken at Tsaopo in north-central Szechwan. Beyond the fact of its being a forest dweller, nothing has been recorded of its habits.

Specimens examined:—The following eight:

Hupei: Ichang, 5, including the type (B.M.).

Szechwan: upper Min River, 2, type and paratype of *T. minax* (B.M.); Tsaopo, 1 (M.C.Z.).

324. *Trogopterus xanthipes edithæ* Thomas

Trogopterus edithæ Thomas, Ann. Mag. Nat. Hist., ser. 9, vol. 11, p. 658, 1923.

Pteromys xanthipes Pousargues, Bull. Mus. d'Hist. Nat., Paris, vol. 2, p. 181, 1896 (in part).

Trogopterus ?mordax Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 14, p. 473, 1914.

Type specimen:—A young-adult male, skin and skull, No. 23.4.1.32, British Museum, from the northwest flank of the Likiang Range, Yunnan, China. Collected by George Forrest in February, 1922.

Description:—This is a decidedly grayer race than those to the north, the tips of the particolored hairs of the head and back being paler, buffy instead of bright ochraceous, and many of them gray. The top of the head and the cheeks, except for the rufous circle about the eye, are gray; the backs of the ears are black, as are the two well-marked tufts of long hairs at the anterior and posterior base of each ear. From the axilla outward to the hand and including

that member, the color is brighter, nearly rufous, sharply defined from the whitish of the under side along the anterior border of the propatagium. Behind the hand the edges of the membrane are mixed gray, then clear gray at the extreme edge. The hind feet are rufous, slightly darker than the fore feet. Ventrally the chin is ochraceous, and there is a slight wash of the same on the under side of the plagiopatagium, just back from its edge. Elsewhere on the lower side the bases of the hairs are pearly gray and their tips white. The soles of the hind feet are thickly haired, soiled grayish. The tail is colored above like the back, but the long black hairs predominate toward the tip, while on the under side the distal two-thirds is black, the basal third grayish, tipped with ochraceous.

The skull, according to Thomas, is about as in typical *T. xanthipes*, smaller than in *T. x. mordax*.

Measurements:—No external measurements are available except those given by Thomas for the type: head and body, 268 mm.; tail, 260; hind foot, 56; ear, 30.

For cranial measurements, see table under *T. xanthipes xanthipes*.

Occurrence and Habits:—This southwestern race of *Trogopterus* is decidedly grayer than the "yellower" forms to the north, yet it seems clear that they are all geographic races of one species. Its presence was apparently first made known in southwestern China by Prince Henri d'Orléans, who brought back three from Yunnan in the course of his expedition through that country (Pousargues, 1896a). I also refer to this species the specimen recorded tentatively as *T. ?mordax* by Thomas (1922b, p. 397) from the Mekong valley, 9,000 feet, 28° north, but it is in too poor a condition to allow of positive identification. In addition to the type from the Likiang Range, I am now able to record three others (in the Museum of Comparative Zoölogy) taken by Dr. Joseph F. Rock on the western slopes of the same range at an elevation of 7,800 feet in December, 1931. He writes that they were "shot at night with electric torches from the tops of large trees where they were feeding on the leaves of oaks. They sailed from a large limestone cave in a cliff on to the trees. We could hear them sailing out and striking the trees." From the same caves came two other species of flying squirrel, *Petaurista alborufus ochraspis* and *Pteromys alboniger orinus*. Rock's conjecture that they were feeding on oak leaves, could it be substantiated, would be very interesting, and might throw light on the use of the remarkable teeth in *Trogopterus*. To the northeast the range of this race doubtless extends into Szechwan. A. B. Howell (1929) has recorded a single specimen from Wa Shan in that province, the most northeastern record for the race, and Brooke Dolan in 1934-36 obtained a skin at Batang.

Specimens examined:—Six namely:

Yunnan: western slopes of the Likiang Range, 3 (M.C.Z.), 1 (B.M.); Mekong valley, 1 (B.M.).

Szechwan: Batang, 1 trade skin (A.N.S.P.).

Family CASTORIDÆ

BEAVERS

The beavers constitute a well-marked family, resembling the squirrels in the wide articulation of the jugal bone with the maxillary, and in the small antorbital foramen for the transmission of a branch of the facial nerve. They are adapted for an aquatic life by the complete webbing of the hind feet, while the tail is broad, scaly, somewhat oval in dorsal aspect and much flattened in the vertical plane, serving as a rudder, and a prop when the animal is sitting erect. The peculiar double nail of the fourth hind claw is said to serve as a comb in dressing the fur. The fore feet are small, with powerful digging claws. The skull has large strong incisors for cutting wood; the cheek teeth are four on each side in each jaw, with the formula: $i.1 \frac{1}{2} c.0 pm.1 m.3 \frac{2}{3} = 20$. These teeth are almost permanently growing, with long shafts of the same pattern at different levels of wear, and show on the lingual side of the upper series a single shallow reëtrant of enamel, on the labial side three reëtrants, much deeper, extending nearly across the crown of the tooth. This provides a rough surface of alternating harder and less-hard substance for grinding. The base of the skull has a curious shallow pit in the basioccipital region.

There is but a single living genus, *Castor*, whose distribution extends, or formerly did, across the north temperate zone of Eurasia and North America. A single race of the European Beaver just reaches the northwestern border of Mongolia.

Genus *Castor* Linnæus

Castor Linnæus, Syst. Nat., ed. 10, vol. 1, p. 58, 1758.

The more obvious characters of the genus have already been mentioned; for an excellent and detailed account of the characters of the European species, see Miller, 1912.

325. *Castor fiber birulai* Serebrennikov

MONGOLIAN BEAVER

Castor fiber birulai Serebrennikov, Compt. Rend. Acad. Sci. URSS, vol. 30, p. 276, fig. 2 (skull), 1929.

Type specimen:—A skin, without skull, of a male, No. 19424, in the Zoological Museum of the Academy of Sciences, Leningrad, U. S. S. R., from the Bulungun River, western Mongolia, south of Kobdo. Collected in 1898 by P. Kozlov's Tibetan Expedition.

Description.—According to its describer, this race is a darker and brighter brown than its nearest neighbor, *C. f. pohlei*, from the Ural Mountains, itself one of the palest of the Eurasian races. The back is nearly "mikado brown," the sides and rump slightly paler; cheeks, throat, and lips yellowish brown; under surfaces grayish brown; hands and feet brown.

The skull differs from that of European beavers chiefly in its massiveness and breadth, particularly in the broad thick rostrum and the short, broad nasals; the pterygoids also are wider apart.

Measurements.—No measurements of the type or other specimens are published by the describer.

Occurrence and Habits.—No doubt the Old World Beaver once extended its range continuously across the northern forested parts of the Eurasian continent, but today it is found in small and more or less isolated colonies in southeastern Norway, western Poland, on the River Elbe in Germany, on the lower Rhone in France, in the Ukraine, and on the northeastern slope of the Ural Mountains. To the eastward its presence in Asia seems to be limited at the present time to a small area in western Mongolia, along the Bulungun River to the south of Kobdo. In 1885, according to Grevé (1903), there were beaver on the Mongolian border along the tributaries of the Beikem River, but they had already disappeared from the Lake Baikal region.

The Russian naturalist Serebrennikov (1929) has recently reviewed the status of the Old World beavers and has described the Mongolian race, naming it in honor of Professor A. A. Birula of the Academy of Sciences at Leningrad. His material consisted of an adult male skin (the type) and the skins and skulls of two other immature specimens from the same locality. The chief distinguishing characters appear to be cranial.

Specimens examined.—None.

SUPERFAMILY MUROIDEA

MOUSE-LIKE AND RAT-LIKE RODENTS

In this superfamily the simple, round antorbital foramen of the squirrel-like mammals becomes enlarged dorsally for the passage of a small slip from the masseter muscle. According to the classification of Miller and Gidley, the group is characterized by the "masseter lateralis seldom reaching superior border of rostrum, and never doing this to exclusion of masseter medialis." The group corresponds more or less nearly to the Myomorpha of the older classifications, except that the jerboa-like species are eliminated, as well as some others, to form a superfamily Dipodoidea. Of the Asiatic families included, all belong to the "four-cusped series" in which the modifications of the

cheek teeth are "based on an underlying quadritubercular structure." These families are: the Cricetidæ, or hamsters and field mice; the Platacanthomyidæ, including the peculiar genus *Typhlomys*; the Rhizomyidæ, represented by the fossorial cane rats; the Spalacidæ with the fossorial *Myospalax*; and finally the typical Muridæ, with their tubercular type of molar, having three instead of two rows of cusps.

Family CRICETIDÆ

HAMSTERS AND VOLES

The hamsters and voles are properly regarded as forming a family apart, distinguished by possessing three maxillary teeth on each side, in each jaw, while the pattern of these teeth consists of a double line of cusps, which may be either rounded or more or less triangular, and the teeth themselves either rooted or growing from persistent pulps. The zygomatic root forms a broad plate, the anterior border of which bounds a deep antorbital foramen with the upper part broad for the passage of muscle, while the lower portion is narrower and transmits a branch of the facial nerve.

Three subfamilies are represented in China and Mongolia, the essential characters of which are as follows (taken from the summary by Miller and Gidley):

KEY TO THE SUBFAMILIES OF CHINESE AND MONGOLIAN CRICETIDÆ

- A. Molars rooted, their crowns either tuberculated or higher and with flattened summits and their prisms not opposite; skull not specially modified. Subfamily Cricetinae
- B. Molars rooted and hypsodont, flat-crowned in adults, with their prisms opposite; posterior part of the skull more or less enlarged, especially the auditory bullæ; saltatorial forms. Subfamily Gerbillinae
- C. Molars tending to be ever-growing, or developing roots late in life; enamel pattern consisting of alternating triangles, the first two molars terminating in an angle; a distinct postorbital ridge or process on the squamosal. Subfamily Microtinae

Subfamily CRICETINÆ

HAMSTERS AND THEIR ALLIES

Of this subfamily four genera are known from China and Mongolia, three of which are small hamsters confined to the northern and more desert part of this area, burrowing forms with short or even vestigial tails, white feet and under parts; the fourth genus is longer-tailed, possibly with different habits, but is known by only a few specimens from southern Kansu. The pattern of

the molars with their double series of tubercles is essentially similar in all, with minor variations in the details. The following key to the genera is based on external characters.

KEY TO GENERA OF CHINESE AND MONGOLIAN CRICETINÆ

- A. Tail considerably less than half the length of head and body.
 - a. Soles of the hind feet naked in their distal half; tail longer than hind foot . . . *Cricetulus*
 - b. Soles of hind feet densely hairy throughout; tail barely as long as hind foot or less.
 - a'. A black median line on the back, white of lower side encroaching upon the dorsal coloring in three or four deep convex areas on the sides *Cricetiscus*
 - b'. No black median line, line of demarcation between color of back and the white under parts straight along the flanks. *Phodopus*
- B. Tail shaggy-haired, about half the length of head and body. *Cansumys*

Genus *Cricetulus* Milne-Edwards

SMALL HAMSTERS

Cricetulus Milne-Edwards, Ann. des Sci. Nat., Zool., ser. 5, vol. 7, pp. 375, 376, 1867; Recherches pour servir à l'Hist. Nat. des Mammifères, p. 133, 1868-74 (as a subgenus of *Cricetus*).

Urocrinetus Satunin, Annuaire Mus. Zool. Acad. Imp. Sci. St. Pétersbourg, vol. 7, p. 573, 1902.

Tscherskia Ognev, Dnev. Zool. otd. Obsc. Liub. Jest., Moscow, vol. 11, p. 102, 1914.

The smaller hamsters of this genus bear a considerable resemblance to their American relatives, the white-footed mice of the genus *Peromyscus*, in their white feet, large, delicate ears, and white bellies, but are all short-tailed, more or less burrowing species, instead of long-tailed and partly arboreal. They inhabit open country, fields and borders of the desert. Milne-Edwards pointed out that they differ from the typical hamsters of the genus *Cricetus* not only in their more slender, mouse-like form, but also in the weaker, more slender skull, and less fossorial feet. The mammæ are said to be four pairs, and there are cheek pouches for food storage. The brain case is full and rounded, but little flattened above, the edges of the interorbital space almost square but not beaded. The upper teeth when but slightly worn show an inner and an outer series of nearly opposite cusps, three pairs on the first molar, two on the second and third, although the third molar is slightly smaller than the second, while the first is the largest of the series. The lower teeth much resemble the upper, but the anteriormost is not so distinctly divided at its front end into two cusps.

In his original account of the characters Milne-Edwards used the name he proposed in a generic sense, and stated that the group contained several small species, of which the only one specifically mentioned is *Cricetulus griseus*. In his fuller account in the "Recherches," he makes *Cricetulus* a subgenus of *Cricetus*, and includes in it three Chinese and five other species, no one of which

is selected as the type. Palmer in his "Index Generum Mammalium" (1904) says that *Cricetulus griseus* is the type, a statement that may be taken as implying the selection of this animal.

Satunin's *Urocrinetus*, proposed to include *Cricetulus longicaudatus*, *C. kamensis*, and similar species with rather longer tails, is regarded by Thomas as a synonym of *Cricetulus*, and the same seems to be true of the name *Tscherskia* proposed by Ognev for a new species, *T. albipes*, which is probably a synonym or possibly an Ussuri race of the large *Cricetulus triton nestor*.

KEY TO CHINESE AND MONGOLIAN SPECIES OF *Cricetulus*

- A. Size small, head and body less than 140 mm.
 - a. Tail longer than hind foot.
 - a'. A black line in the middle of the back.
 - 1. General color pale ochraceous..... *C. barabensis griseus*
 - 2. Paler, general color buffy..... *C. barabensis obscurus*
 - b'. No black median line, back concolor; tail about twice the length of the hind foot.
 - a". Hair of throat and inguinal region white to the base. *C. migratorius griseiventris*
 - b". Hair of under parts everywhere conspicuously gray at base *C. longicaudatus*
 - 1. Back uniformly grayish..... *C. longicaudatus longicaudatus*
 - 2. Center of back much darker..... *C. l. nigrescens*
 - b. Tail exceedingly short, hardly if at all longer than hind foot..... *C. eversmanni curtatus*
- B. Size larger, head and body more than 140 mm..... *C. triton*
 - a. Feet white.
 - 1. Grayish brown, washed with ochraceous (Shantung to southern Shansi)..... *C. triton triton*
 - 2. Color darker, gray above (southwestern Shensi).... *C. triton collinus*
 - 3. Color slightly paler (edge of Ordos Desert)..... *C. triton incanus*
 - b. Feet with the ankles dark..... *C. triton fuscipes*

326. *Cricetulus barabensis griseus* Milne-Edwards

STRIPED-BACKED HAMSTER

Cricetulus griseus Milne-Edwards, Ann. des Sci. Nat., Zool., ser. 5, vol. 7, p. 376, 1867.

Cricetus (Cricetulus) griseus Milne-Edwards, Recherches pour servir à l'Hist. Nat. des Mammifères, p. 133, pl. 12, fig. 1; pl. 13, figs. 1-1h, 1868-74.

Cricetus (Cricetulus) obscurus De Winton and Styan, Proc. Zool. Soc. London, 1899, p. 575.

Cricetulus barabensis griseus Chaworth-Musters, Ann. Mag. Nat. Hist., ser. 10, vol. 12, p. 223, 1933.

Type specimen.—The original specimen was sent by Père Armand David to the Muséum d'Histoire Naturelle at Paris from the vicinity of Peiping, Hopei, China.

Description.—A short-tailed buffy species with a narrow black stripe in

the middle of the back. Dorsal surface of the head and body from the muzzle to the root of the tail, and laterally to the cheeks, upper arm and thighs, ochraceous buff, brighter and even tinged with tawny in adults, but duller, slightly drabby in less mature individuals. An ill-defined median stripe of black commences on the forehead or often on the lower nape and extends nearly or quite to the root of the tail. Lower limbs and backs of feet pure white. Ears blackish on both the proëctote and metentote, their rims conspicuously edged with white. Tail mixed blackish and white above, pure white below. Ventral surface of the body with the fur dark gray to slaty at the base, tipped with white.

The skull has a nearly straight, tapering rostrum and a dorsal profile very little but evenly convex. The zygomatic plate has its anterior and posterior borders nearly vertical, and the jugal arch is very slender. The tooth rows are slightly divergent forward, and the incisive foramina end at the level of the first molar.

Measurements.—Collectors' measurements are as follows:

No.	Head and body	Tail	Hind foot	Ear	Locality
57924	96	25	16	14	Hopei
57930	93	28	15	15	Hopei
57934	92	—	15	14	Hopei

CRANIAL MEASUREMENTS OF *CRICETULUS BARABENSIS* RACES

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper tooth row	Lower tooth row	Locality
<i>C. barabensis griseus</i>									
57924	26.1	22.7	12.6	13.8	11.0	5.0	4.0	3.9	Hopei
57930	25.5	22.4	12.4	13.8	11.0	5.3	3.8	3.9	Hopei
57934	25.5	22.6	12.5	12.6	10.4	4.9	3.8	3.8	Hopei
<i>C. barabensis obscurus</i>									
57812	25.7	22.6	12.6	13.0	10.5	5.3	3.8	3.8	Mongolia
57922	25.8	23.0	13.0	13.7	11.2	5.5	3.6	3.8	Mongolia
84022	27.1	23.5	13.0	14.4	11.7	5.5	3.7	3.8	Mongolia

Occurrence and Habits.—The Striped-backed Hamster is a common species in northeastern China, especially in the provinces of Hopei, Shantung, and eastern Shensi. In the first-named province Dr. Andrews secured a large series about Peiping (topotypes) and at Shanhaikwan, and found it common also at Chimo in the Shantung peninsula. Thomas (1908d) records the species from Chefoo and Aisan (to the westward), as well as from Tientsin. In much-cultivated areas, however, it is less plentiful, and M. P. Anderson, who collected the Chefoo series, notes that it was almost the only mammal in the fields

thereabout. "Its burrows were most often in small banks in the gardens, but sometimes occurred between the rows in wheat fields." A female from Yulinfu, Shensi, was regarded by Thomas (1909, p. 974) as the typical race of the species, and Sowerby (Clark and Sowerby, 1912, p. 180) notes that it takes the place of *Cricetulus "andersoni"* (= *longicaudatus*) in and on the borders of the open country, burrowing usually along the sides of cultivated fields, irrigation ditches, and water courses. It is typically a species of arid country, and is replaced on the borders of the Gobi by the slightly paler race *C. b. obscurus*.

Fortuyn (1927, 1928) has summarized various observations on the habits and growth of this species as observed about Peiping. The animals retire to their burrows for the winter months, reappearing about February or March, and no doubt live in part on the stores of seeds and grain which they lay up. Several litters are produced in the year, and adults "visibly pregnant" were collected between February 2 and November 1. The average number of young per litter was found to be about 6.5. Out of twenty-seven litters, there was a single litter of one young, one litter of ten, and nine litters of six each. Again, in thirty-nine litters, there were fourteen of six each, and only one of ten. The smallest pregnant female measured 80 mm. in length, while adults of both sexes may reach a total length of 120.

Three immature specimens in the British Museum, apparently all from the same litter, are interesting genetically in having lost the black element of pigmentation, so that their coat is uniformly buff above, lacking any sprinkling of black hairs as well as the black dorsal line.

Specimens examined.—In all, seventy-seven, as follows:

Hopei: Peiping, 8; Shanhaikwan, 35.

Jehol: two hundred kilometers northeast of Jehol, 1 (M.C.Z.).

Shantung: Chimo, 29; Tsinan, 1; Weihsien, 3 (B.M.).

327. *Cricetulus barabensis obscurus* (Milne-Edwards)

Cricetus (Cricetulus) obscurus Milne-Edwards, Recherches pour servir à l'Hist. Nat. des Mammifères, p. 136. pl. 12, fig. 2; pl. 13, figs. 2-2c, 1868-74.

Cricetus mongolicus Thomas, Proc. Zool. Soc. London, 1888, p. 134, footnote (not *Hesperomys obscurus* Waterhouse, if *Hesperomys* be united with *Cricetus*).

Cricetulus dichrootis Satunin, Annuaire Mus. Zool. Acad. Imp. Sci. St. Pétersbourg, vol. 7, p. 567, 1902, Gorban-angyr Gol, Nan Shan.

Cricetulus kozlovi Satunin, *ibid.*, p. 570. Sachow, Nan Shan.

Cricetulus griseus obscurus Thomas, Proc. Zool. Soc. London, 1908, p. 107.

Cricetulus barabensis obscurus Chaworth-Musters, Ann. Mag. Nat. Hist., ser. 10, vol. 12, p. 223, 1933.

Type specimen.—The original specimen was collected by Père Armand David at "Sartchy" or Saratsi, Shansi, China, and is presumably in the Muséum d'Histoire Naturelle at Paris. Its number is not specified.

Description.—It is unfortunate that the type locality is one of somewhat

intermediate conditions between the desert and the fields of Peiping. Milne-Edwards believed his specimen represented a darker animal than true *Cricetulus griseus*, and Thomas, in urging that the name might be regarded as applying to the desert form of Shansi, remarked that a series from Mongolia in summer is slightly darker than the Chefoo series in winter coat. Yet with a good series of both forms at hand it is clear that in the brighter, more russet phase of pelage, those from Mongolia are paler, near pale buff instead of with a distinctly ochraceous tone, while the grayer specimens are hardly distinguishable. The dorsal black line is much more indistinct in the desert race and in some individuals is practically obsolete. At best this is a poorly marked subspecies.

The cranial characters were supposed by Milne-Edwards to separate this animal, but the differences are inconstant.

Measurements.—For cranial measurements, see table under preceding race.

Occurrence and Habits.—The type locality, Saratsi, lies in northern Shansi, so that the small series collected by the American Museum Asiatic Expeditions are practically topotypes of *Cricetulus b. obscurus*. To the west and north, this hamster is found in suitable places over much of the Gobi, and is represented in the collections made, by specimens from the following localities: Tuerin, Loh, Uskuk, Gun Burte, Tsetsen Wang, Tsagan Nor, and Sainnoin Khan. Others are from Erhlien and Orok Nor. Forty miles southwest of Tsetsen Wang, a series was caught by Dr. Granger along the banks of a stream in the canyon. It seems very likely that the range extends very much farther to the westward, for after a careful perusal of the descriptions of *C. dichrootis* and *C. kozlovi*, I am convinced that they represent the same animal. Probably all these striped-backed hamsters will eventually prove to be races of the species described by Pallas as "*Mus furunculus*," type locality between Barnaul and the Kasmala River, western Siberia, a conclusion now confirmed by Chaworth-Musters (1933), who, in a paper written since this decision was reached, has shown that *Mus furunculus* is but a renaming of *Mus barabensis* Pallas, and that both *C. b. griseus* and *C. b. obscurus* are subspecies of the latter.

Specimens examined.—In all, thirty-three, namely:

China:

Shansi: Kweihwacheng, 7.

Mongolia:

Gun Burte, 1; near Erhlien (= Iren Dabasu), 2; east end of Lan Shan, 2; Loh, 3; Orok Nor, 1; Sainnoin Khan, 3; Tsagan Nor, 5; Tsetsen Wang, 6; Tuerin, 2; Uskuk, 1.

328. *Cricetulus migratorius griseiventris* Satunin

Cricetulus phaus griseiventris Satunin, Annuaire Mus. Zool. Acad. Imp. Sci. St. Pétersbourg, vol. 7, p. 566, 1902.
Cricetulus migratorius griseiventris Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 19, p. 454, 1917.

Type specimen.—A skin and skull in the collection of the Zoological Museum of the Academy of Sciences, Leningrad, U. S. S. R., from the Bisshen Gol, Altain Nuru, Gobi Altai, Mongolia.

Description.—Said to be larger than the western forms, fur longer, 10 mm. or more on the back. Color above pale gray, more or less strongly suffused with buffy or fulvous. Below, the hairs are snowy white to their bases, on the throat and inguinal region, but on the belly are broadly slaty at the bases.

Measurements.—Thomas gives the following measurements: head and body, 120 mm.; tail, 27; hind foot, 16. Skull length, 30 mm.; upper tooth row, 4.5.

Occurrence and Habits.—Although described from the Gobi Altai in western Mongolia, Thomas states that this race has a wide distribution in central Asia, Samarkand and eastward along the Tien Shan. Very likely the specimen figured as *C. arenarius* by Buechner in the Atlas of the Przewalski Expedition is the same. Its relationship to other eastern species is in much need of elucidation.

Specimens examined.—None.

329. ***Cricetulus longicaudatus longicaudatus*** (Milne-Edwards)

Cricetus (Cricetulus) longicaudatus Milne-Edwards, Recherches pour servir à l'Hist. Nat. des Mammifères, p. 136, pl. 12, fig. 3; pl. 13, figs. 3, 3a, 1868-74.

Cricetulus andersoni Thomas, Proc. Zool. Soc. London, 1908, p. 642.

Cricetulus longicaudatus Thomas, *ibid.*, p. 643.

Cricetulus longicaudatus andersoni Argyropulo, Zeitschr. f. Säugetierk., vol. 8, p. 147, 1933.

Type specimen.—The individual on which the species is based came from "la Mongolie chinoise," probably from the vicinity of Saratsi in northern Shansi, "comme les précédentes," that is, *Cricetus obscurus* and *C. griseus*. It was there that Père David resided for a time and probably collected the type specimen, which is presumably still in the Paris Museum.

Description.—Upper parts, including the top of the muzzle, cheeks to below the level of the eyes and ears, the back to the base of the tail, and the upper part of the humerus and femur, a uniform buffy drab, slightly darker in the center of the back. Ears, both inside and outside, on the exposed parts, blackish, with white rims and tips. Tail, above, like the back; below pure white. A spot on each side of the muzzle at the base of the vibrissæ, the hands and feet pure white, the rest of the under parts gray at the bases of the hairs, then tipped with white. The distinguishing points are the uniform coloring above, absence of a median black line, and the gray-based hairs of the belly, combined with the long tail which is about twice the length of the hind foot.

Rarely individuals may have most of the hairs of the lower surface of the body white to the roots, as, apparently, according to Thomas, was the case in the type.

Measurements.—The dimensions of fresh specimens are as follows:

No.	Head and body	Tail	Hind foot	Ear	Locality
45459	87	30	15	20	Shansi
57669	84	37	17	17	Mongolia
57684	95	41	18	16	Mongolia
57699	87	35	16	17	Mongolia
57746	84	35	17	17	Mongolia
59771	100	27	16	18	Mongolia

CRANIAL MEASUREMENTS OF *CRICETULUS LONGICAUDATUS*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width outside molars	Upper tooth row	Lower tooth row	Locality
<i>C. longicaudatus longicaudatus</i>									
45459	23.7	21.0	11.4	12.5	10.5	4.7	3.6	3.7	Shansi
45460	23.2	20.0	10.8	11.8	10.8	4.6	3.3	3.7	Shansi
13656 (MCZ)	23.7	20.5	11.5	12.2	10.7	4.9	3.8	3.9	Shansi
57653	25.5	21.5	12.0	12.6	11.7	5.0	3.8	3.7	Mongolia
57669	25.5	21.5	11.8	12.6	10.9	4.9	3.6	3.8	Mongolia
57672	25.5	22.0	12.2	12.6	11.5	5.1	3.7	3.8	Mongolia
57684	26.5	22.6	12.4	13.3	11.0	5.1	3.7	3.7	Mongolia
57699	26.4	22.6	12.5	13.5	11.9	5.0	3.8	3.9	Mongolia
57746	26.5	—	12.3	13.0	11.0	5.0	3.8	3.8	Mongolia
<i>C. longicaudatus nigrescens</i>									
56307 (type)	26.0	22.5	12.5	—	11.7	—	4.1	4.0	Hopei

Nomenclature.—There can be no doubt that Argyropulo (1933, p. 147) is right in making *longicaudatus* and *andersoni* Thomas conspecific, but since the type localities of both are in northern Shansi, that of the latter near Taiyuan, it is equally obvious, as specimens show, that the two are synonymous instead of subspecifically related. Thomas was apparently misled by supposing that *C. longicaudatus* was pure white to the bases of the hairs on the under side, a condition which is rare.

Occurrence and Habits.—This is the common small hamster of the desert country from Shansi westward across the Gobi. M. P. Anderson, who collected the type and other specimens of *C. "andersoni"* about Taiyuanfu in Shansi, found them abundant about cultivated fields, making horizontal burrows just beneath the surface. Sowerby (Clark and Sowerby, 1912, p. 179) writes that they were common in both Shansi (Taiyuanfu) and Shensi (Yenanfu), but farther west on the borders of Kansu they were rare, although a few were

taken fifteen miles northeast of Chingning. Thomas (1911d, p. 173) has also recorded the species from sixty miles southeast of Minchow, and ten miles south of Taochow in Kansu, as well as others from Singanfu in southern Shensi, localities which probably mark nearly the southwestern and southern borders of its range. Anderson did not find it in the Ordos Desert, although it was plentiful at localities in Shansi, as at Fenchowfu, Paotehchow, Ningwufu, and near Kolanchow. Dr. R. C. Andrews secured a series at Kweihwacheng in the same province. In Mongolia he found it very abundant at Artsa Bogdo and obtained a large series, as well as single specimens at Uskuk and Tsetsen Wang, but was not able to follow its distribution elsewhere in the Gobi to determine if it is present along the southern edge, or exactly how it reaches the west-central part of this area. The native Chinese name, according to Sowerby, is "tsang-erh," which signifies a "storer."

Specimens examined:—In all, one hundred and fifty-four, namely:

China:

Shansi: Kweihwacheng, 7; Heshuin, 7; Lungwang Shan, 1.

Mongolia:

Artsa Bogdo, 137; forty miles southwest of Tsetsen Wang, 1; Uskuk, 1.

330. *Cricetulus longicaudatus nigrescens* G. M. Allen

Cricetulus andersoni nigrescens G. M. Allen, Amer. Mus. Novitates, no. 179, p. 2, 1925.

Cricetulus longicaudatus nigrescens Argyropulo, Zeitschr. f. Säugetierk., vol. 8, p. 147, 1933.

Type specimen:—An adult male, skin and skull, No. 56307, American Museum of Natural History, from one hundred miles northeast of Peiping, Hopei, China. Collected March, 1922, by the Central Asiatic Expeditions.

Description:—Similar to *C. longicaudatus*, but the dorsal surface of head and body much darkened by black hairs. General color above, a buffy gray heavily lined with black, particularly over the lower part of the back, with in some specimens a tendency to form a very indistinct dark line medially. This general color is the result of a mixture of long, black-tipped hairs, with the more numerous hairs having the basal three-fourths slaty and the tip pale buff. At the sides of the body between fore and hind legs these latter hairs predominate, giving a nearly clear "light ochraceous buff." A small indistinct area behind each ear is similar. Upper side of the tail dusky, with a few scattered white hairs, lower side white. Ears blackish brown ("natal brown"), their tips narrowly edged with white. Backs of the feet pure white. Upper lips and entire under surface of the body and limbs white, with a distinct buffy wash on the chest, the bases of the hairs everywhere slaty.

The skull is like that of the typical race.

Measurements:—No flesh measurements are available, but the size is apparently as in the typical race.

For skull measurements, see the table under *C. longicaudatus longicaudatus*.

Occurrence and Habits:—This eastern representative of the more desert-living race, *C. longicaudatus*, was discovered by Dr. R. C. Andrews's expeditions at about one hundred miles northeast of Peiping, and is easily distinguishable by its much darker dorsal coloring, lack of median black stripe, and the buffy wash on the chest. With the merging of *andersoni* in *longicaudatus*, *C. l. nigrescens* becomes a subspecies of the latter.

Specimens examined:—In all, twenty-three, from Hopei, one hundred miles northeast of Peiping.

331. *Cricetulus eversmanni curtatus* G. M. Allen

Cricetulus migratorius curtatus G. M. Allen, Amer. Mus. Novitates, no. 179, p. 3, 1925.

Type specimen:—An adult male, skin and skull, No. 57873, American Museum of Natural History, from Iren Dabasu, Inner Mongolia. Collected May 2, 1922, by the Central Asiatic Expeditions.

Description:—A rather large hamster with very short tail, the basal hairs of which grow out long, nearly reaching its tip and producing a rather conical appearance. General color of the upper parts from the nose to the tail and laterally as far as the vibrissæ, cheeks, shoulder, and lower thigh a pale buffy, nearly "cinnamon buff" of Ridgway, faintly and evenly lined with fine, black-tipped hairs. Half-way between the eye and ear an indistinct grayish-white bar extends up from the white of the throat across the cheek on each side. A small tuft of white hairs is present at the anterior base of the ear, and an ill-defined pale-buffy patch marks the posterior base. Outer surface of the ears scarcely darker than the back, thinly covered with dusky and white hairs. Lips, including the bases of the vibrissæ, the entire forearm and foot, and the hind leg from the lower part of the thigh, the tail, the sides and belly, white, the hairs with their extreme bases slaty gray except on the chin and upper throat or sometimes between the fore legs. Immatures are drab-gray above with less of the pale-cinnamon tint, and the upper side of the tail may be narrowly blackish.

The skull is differently proportioned from that in the *C. migratorius* group, with a more nearly circular brain case, broader and shorter rostrum. The incisive foramina extend to the level of the first maxillary tooth, and the interpterygoid fossa extends forward to the level of the last molar. The zygomata are rounded and projecting.

Measurements:—The dimensions of fresh specimens as recorded by the collector are as follows:

No.	Head and body	Tail	Hind foot	Ear	Locality
57828	128	24	19	17	Mongolia
57835	105	21	17	15	Mongolia
57842	100	17	18	16	Mongolia
57858	130	21	19	15	Mongolia
84025	110	22	18	14	Mongolia
84026	118	25	18	14	Mongolia
84023	120	20	18	12	Mongolia
84029	110	22	20	18	Mongolia
85209	110	19	18	11	Mongolia
84021	117	21	18	15	Mongolia

CRANIAL MEASUREMENTS OF *CRICETULUS EVERSMANNI CURTATUS*

No.	Greatest length	Basal length	Palatal length	Zygomastic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
84025	30.6	27.5	15.7	17.6	13.5	6.5	4.4	4.8	Mongolia
84023	32.5	28.7	16.0	18.3	13.0	6.5	4.5	4.5	Mongolia
84027	31.2	27.8	15.6	16.5	12.4	6.5	4.5	4.5	Mongolia

Nomenclature:—Of the various species of small hamster described by Pallas in his "Reise" and the "Novæ Species e Quadrupedum et Glirium Ordine," Thomas has regarded both "*Mus accedula*" and *M. phæus* as synonyms of the name *M. migratorius*, partly, it would seem, on the ground that all are from the same general region, and the descriptions are not particularly diagnostic. The figures (uncolored) are perhaps more characteristic; thus *M. furunculus* has a black dorsal line; *M. sungorus*, with the pale areas invading the sides, is obviously a *Cricetiscus*, while *M. phæus*, with its exceedingly short tail and more obtuse muzzle with convex profile, may really represent a species distinct from *M. accedula* = *migratorius*, but this seems at present impossible to determine. However, Dr. B. Vinogradov of the Academy of Sciences at Leningrad assures me that the stumpy-tailed species is *Cricetulus evermanni* Brandt, a name which Thomas had also relegated to the synonymy of *C. migratorius*. He has sent me specimens of this animal from the Kirghiz steppes, and it becomes clear that the mouse I described as *C. migratorius curtatus* is instead a race of the same species, much paler in color but agreeing in its very short tail, with longer projecting hairs at its base. It is also of greater bodily size and has a larger skull with proportionately less slender muzzle and brain case and much more spreading zygomata. The Mongolian race of this animal lacks the more tawny shade of the Siberian hamster, while the gray of the throat, which in the latter tends to form a distinct patch, is instead much less contrasted owing to the white tips of the hairs being much

longer. More recently Argyropulo (1933) has proposed to distinguish a new subgenus *Allocricetulus* for this and the typical race *eversmanni*, making the latter the type species.

Occurrence and Habits.—In its very pale sandy color above, this stumpy-tailed hamster must harmonize closely with the pallid color of the desert of which it seems to be characteristic. Dr. Andrews and his party succeeded in obtaining a splendid series from the following places in the Gobi: Gun Burte (6,800 feet), Tsagan Nor, where it seems to have been common, Loh, Uskuk, Tuerin, Iren Dabasu (type locality), Pang Kiang, Orok Nor, Kholobolchi Nor, and Hatt-in-Sumu. The greater part of the series was secured in 1922, when, as Dr. Andrews has described, the Tsagan Nor was at high water, and the surrounding sand-dune region held at the bottoms of little valleys an

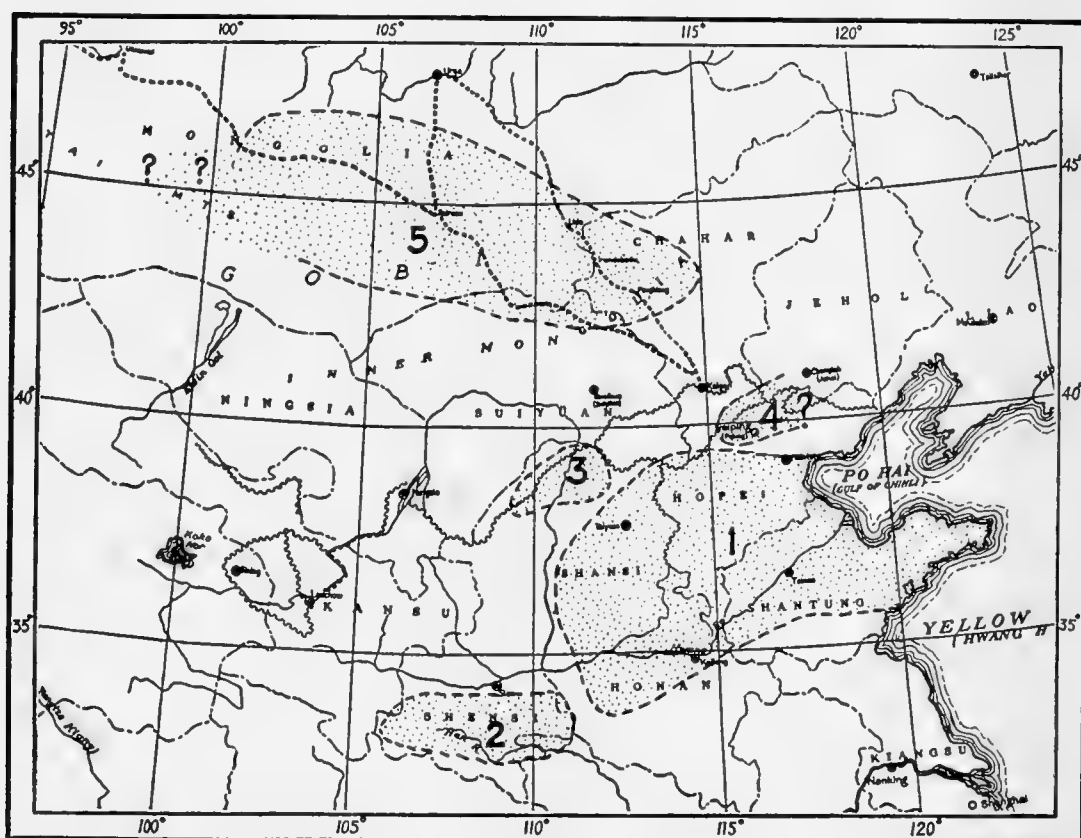


FIG. 28. Distribution Map.

Cricetulus

- | | |
|----------------------------------|------------------------------|
| 1. <i>C. triton triton</i> | 3. <i>C. triton incanus</i> |
| 2. <i>C. triton collinus</i> | 4. <i>C. triton fuscipes</i> |
| 5. <i>C. eversmanni curtatus</i> | |

abundant crop of a wild bush-pea. Here twenty were trapped in that year, while in 1925 when the locality was revisited and the lake found to be much dried up, only one was taken.

Specimens examined:—In all, forty-nine, as follows:

Mongolia: Gun Burte, 7; Tsagan Nor, 22; Loh, 7; Uskuk, 1; Tuerin, 1; Iren Dabasu, 3; Pang Kiang, 2; Orok Nor, 1; Kholobolchi Nor, 3; Tichi Ola, 1; Hatt-in-Sumu, 1.

332. *Cricetulus triton triton* (De Winton and Styan)

Cricetus (Cricetulus) triton De Winton and Styan, Proc. Zool. Soc. London, 1899, p. 575.

Cricetulus triton Thomas, Proc. Zool. Soc. London, 1908, p. 9.

Cricetulus triton triton A. B. Howell, Proc. U. S. Nat. Mus., vol. 75, art. 1, p. 49, 1929.

Type specimen:—A female, skin and skull, No. 99.3.1.14, British Museum, from northern Shantung, China.

Description:—Top of head, cheeks, and the dorsal surface of the body a buffy gray, without trace of a median dark line; the median area of the back is more mixed with all-black or black-tipped hairs than the sides which are usually a clearer pale ochraceous buff. Upper lips, the chin, and the backs of the feet, pure white. Lower surface of the body elsewhere white with gray-based hairs. Tail dark brown above, paler to grayish below. Ears short-haired and dull brownish in color on the exposed portions, their rims minutely edged with whitish. Immature specimens are a nearly uniform dark gray above.

The skull is more strongly built than that of the smaller species of the genus; the upper incisor roots produce a slight swelling at the sides of the rostrum; the nasals are long and narrow, expanding slightly at their distal ends, and the interorbital border is straight-edged, angular, and slightly overhanging. The occipital condyles project strongly behind the general plane of the occiput. The incisive foramina do not quite reach the level of the molar rows which themselves diverge anteriorly. The audital bullæ are more inflated than in the smaller species, and in the median line are distant from each other by only the width of the interpterygoid fossa.

Measurements:—The type was unaccompanied by flesh measurements, but the skin measured approximately: head and body, 150 mm.; tail, 65. A series in the British Museum has the following measurements recorded on the labels:

No.	Head and body	Tail	Hind foot	Ear	Locality
8.2.8.45 BM	135	82	24.0	17.5	Shantung
8.2.8.47 BM	160	79	23.0	20.0	Shantung
8.2.8.50 BM	138	45	23.5	20.0	Shantung
8.2.8.51 BM	150	95	24.0	20.0	Shantung

A skeleton shows 13 thoracic, 7 lumbar, 4 sacral, and 19 caudal vertebrae. There is an entepicondylar foramen in the humerus.

CRANIAL MEASUREMENTS OF *CRICETULUS TRITON*

No.	Greatest length	Basal length	Palatal length	Zygomastic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
<i>C. triton triton</i>									
25867 MCZ	38.7	35.2	18.8	—	15.5	7.0	5.6	5.2	Shantung
25868 MCZ	40.2	37.5	20.0	20.3	14.7	6.8	5.0	5.8	Shantung
25896 MCZ	35.3	32.6	17.0	18.8	14.5	7.0	5.2	5.5	Shantung
29405 MCZ	35.2	33.5	17.7	19.5	14.2	6.9	5.0	5.1	Shantung
99.3.1.14 BM	33.7	—	17.0	19.3	14.5	6.8	5.0	5.0	Shantung
8.2.8.51 BM	38.6	35.7	18.9	21.2	14.9	6.9	5.5	5.4	Shantung
8.2.8.50 BM	34.6	31.5	16.9	18.8	14.2	6.9	5.5	5.4	Shantung
8.2.8.47 BM	40.1	37.0	19.4	21.6	15.8	8.2	4.7	5.0	Shantung
8.2.8.45 BM	37.9	34.9	18.8	19.0	14.5	7.0	5.1	5.5	Shantung
10.5.2.66 BM	37.5	34.5	18.3	(18.0)	14.1	6.9	5.3	5.2	Honan
<i>C. triton fuscipes</i>									
56792 (type)	35.0	35.0	18.5	—	15.5	—	5.5	5.4	Hopei
56335	38.0	34.5	18.8	19.4	15.4	—	5.5	5.5	Hopei
<i>C. triton incanus</i>									
9.1.1.123 BM	41.5	38.5	20.3	22.6	16.2	(7.6)	5.2	5.3	Shansi
9.1.1.122 BM	38.1	35.8	19.0	19.9	15.0	7.6	5.8	5.7	Shansi
9.1.1.127 BM	38.1	35.1	18.5	19.2	14.2	7.0	5.5	5.1	Shensi
9.1.1.125 BM	35.5	31.5	17.3	17.9	14.5	7.0	5.7	5.3	Shensi
<i>C. triton collinus</i>									
56388	37.5	34.6	17.6	19.0	15.3	—	5.2	5.2	Shensi

Occurrence and Habits:—This large and rather long-tailed hamster-mouse seems to be of general occurrence in the dry country of northeastern China. It was first made known from the Shantung peninsula by De Winton and Styan in 1899, but it was not till nearly ten years later that Thomas (1908d, p. 9) recorded others from Chefoo and Weihaiwei in the same province, as well as from Tientsin, Hopei. The collectors of these specimens note "a predilection on the part of these animals to make their burrows in human grave-mounds, on the south side of which they sink a perpendicular shaft." These shafts, according to Sowerby (1914, p. 67), go down into a large storage chamber in which are gathered "enormous quantities of grain during the autumn for winter use. One rat will thus get away with a bushel or more of grain, and, when it is considered that in some districts burrows occur every few yards, it will be realized what a pest these creatures may become. I have known of poor peasants' making a living by digging up these granaries. The Chinese

name 'Pan ts'ang' has reference to this habit, 'ts'ang' meaning a store. . . . They are very fierce and bite savagely." In 1928 six individuals from Shantung were living in the Gardens of the Zoölogical Society of London. The exact limits of the range remain to be worked out. Thomas has recorded specimens (1911) from Kingtzekwan, southwestern Honan, and from Shannanhsien as well as from the Shangchow district of southeastern Shensi, but these are the same as the race *C. t. collinus* that I described in 1925. In central Hopei the race *fuscipes* with dark ankles seems to take the place of the typical form, while to the westward, Thomas has described a paler race, *C. t. incanus*.

Specimens examined:—In all, twenty-four, namely:

Shantung: Chimo, 10; Weihsien, 4; northern Shantung, 2, including the type (B.M.); Weihaiwei, 3 (B.M.); Chefoo, 4 (B.M.); Tsinan, 1 (B.M.).

333. *Cricetulus triton fuscipes* G. M. Allen

Cricetulus triton fuscipes G. M. Allen, Amer. Mus. Novitates, no. 179, p. 5, 1925.

Cricetulus arenosus Mori, Rept. First Sci. Exped. to Manchoukuo, sect. 5, div. 2, pt. 4, p. 64 (English), pl. 8, text figs. 11, 12, March, 1939. Tungliiao, northeast of Jehol.

Type specimen:—An adult male, skin and skull, No. 56792, American Museum of Natural History, from Peiping, Hopei, China. Collected in 1921 by the Central Asiatic Expeditions.

Description:—In general similar to the typical *C. triton triton*, but the ankles and basal part of the metatarsals dusky instead of white like the distal part of the foot. The entire dorsal surface of the body is a nearly uniform buffy, slightly darkened on the lower back by black hairs. Along the flanks and the cheeks these black hairs are fewer or absent, so that the color is clearer, nearly "light ochraceous buff." Ears clothed with short brownish ("fuscous") hairs with a few grayish hairs, especially at the tip of the ear. Chin and a varying median area extending back from it, pure white to the roots of the hairs as well as the hands and wrists. Elsewhere the under side of the body is white, with the gray bases of the hairs showing through. The hind feet are white on the distal part of the metatarsals and on the toes, but the proximal half or third of the metatarsal area is contrastingly dusky ("fuscous"). The tail is thinly haired, dusky above and whitish below.

The skull does not differ from that of the typical race.

Measurements:—No fresh measurements are available. The hind foot in a dry skin is 23 mm., practically as in *C. t. triton*.

For cranial measurements, see table under *Cricetulus triton triton*.

Occurrence and Habits:—The material examined indicates that the representative of *Cricetulus t. triton* in northern Hopei differs in its dark tarsal joint

from the white-footed animal of Shantung, so that I have ventured to describe it as a local race. A. B. Howell (1929) has recorded that examples from near Tientsin, Hopei, are somewhat intermediate in this respect, and very likely the form is not a strongly marked one. It seems probable that *Cricetulus arenosus* recently described by Mori from Tungliao, northeast of Jehol, is merely an immature specimen of this race, so that I have provisionally included the name in its synonymy. The race *C. t. nestor* of Korea is apparently much darker.

Specimens examined.—In all, seven, from Peiping, Hopei.

334. *Cricetulus triton incanus* Thomas

Cricetulus triton incanus Thomas, Abstract Proc. Zool. Soc. London, December 15, 1908, p. 45; Proc. Zool. Soc. London, for 1908, p. 973, 1909.

Type specimen.—A female, skin and skull, No. 9.1.1.123, British Museum, from the mountains twelve miles northwest of Kolanchow, Shansi, China. Collected by M. P. Anderson, 1908.

Description.—This appears to be a paler race than any of the others. "External characters as in true *C. triton* except that the colour is distinctly paler and more drabby (drab-grey) as compared to the darker 'smoke-grey' *triton*; the head and fore back pale clear grey, 'grey No. 3,' markedly different from the comparatively dark grey of *triton*."

"Skull essentially as in *triton*, but rather more delicately built, the nasal region, interorbital space, and brain-case all slightly narrower" (Thomas).

Measurements.—The dimensions of two specimens measured in the flesh are recorded as follows by Thomas:

	Head and body	Tail	Hind foot	Ear
Male	155	85	25	21
Female (type)	168	98	24	21

For skull measurements, see table under *C. t. triton*.

Occurrence and Habits.—"This is evidently a pale inland dry-country form," according to its describer. In addition to specimens from the type locality, northwest of Kolanchow, Shansi, he records four others from Yen-anfu, Shensi, both localities at the edge of the Ordos Desert of yellow sand. A note by the collector, M. P. Anderson, adds: "This large Hamster is rare. They usually reside under bushes at the edge of some farmfield from which they take their food. I have sometimes found green leaves in their pouches, but more often they carry some grain. Their clean-cut burrows usually descend vertically into the earth." Howell records it from northwest of Taiyuanfu, Shansi.

Having examined the original series in the British Museum, I am able to confirm Thomas's statement that they are a very little grayer on the head and shoulders, a general buffy gray above, slightly buffier posterior to the shoulders. The lower back is washed with blackish. On the whole this is a barely distinguishable race.

Specimens examined:—The following six, including the type:

Shansi: twelve miles northwest of Kolanchow, 2 (B.M.); Yenanku, 4 (B.M.).

335. *Cricetulus triton collinus* G. M. Allen

Cricetulus triton collinus G. M. Allen, Amer. Mus. Novitates, no. 179, p. 5, 1925.

Cricetulus triton meihsiensis Ho, Contrib. Biol. Lab. Science Soc. China, Nanking, zool. ser., vol. 10, no. 5, p. 288, text fig. 15, pl. 1, figs. 1-2, 1934.

Type specimen:—An adult female, skin and skull, No. 56389, American Museum of Natural History, from the base of Taipai Shan, Tsingling Mountains, Shensi, China. Collected October 10, 1921, by the Central Asiatic Expeditions.

Description:—In size and general characters like *C. triton triton* but much darker, the tail apparently slightly longer. General color of the upper parts from nose to tail between "drab" and "mouse gray," the individual hairs either entirely black, or with a minute black tip and a broad subterminal band of "warm buff," the latter predominating at the sides of the head and body, giving them a warmer tint. Ears thinly covered with short blackish-brown hairs, except at the extreme edge which is white. Feet and wrists, the chin and a small median spot on the throat, clear white to the bases of the hairs; the lower surfaces elsewhere whitish, the slaty-gray bases of the hairs everywhere showing through. Tail clothed with short blackish-brown ("sepia") hairs, with many whitish hairs on the lower side.

The skull hardly differs from that of the typical race, except that the incisive foramina in adults tend to be longer, reaching about to the level of the cheek teeth; the shape of the interparietal also appears to differ slightly, with its anterior corners tending to be more produced forward, giving a brace-shape instead of a V-shape.

Measurements:—The collector's measurements of the type are: head and body, 155 mm.; tail, 72; hind foot, 24; ear, 22.

For cranial measurements, see table under *C. triton triton*.

Occurrence and Habits:—A series of nine specimens from the base of Taipai Shan, Tsingling Mountains, comes from the northwestern border of the damp, forested area of which Szechwan may be considered the center. The saturate or darkened appearance of this form is therefore what might have been ex-

pected, in contrast to the pale *C. triton incanus* from the borders of the Ordos Desert, or the pale-buffy *C. triton triton* of Shantung. A single specimen from the northern edge of the Tsingling Range, about forty-five miles south of Fengsiangfu, Shensi, is also referred to *C. t. collinus*, and perhaps marks nearly the northern limit of the race. The altitude here is 3,600 feet. Two other specimens from Heshuin, southern Shansi, are very similar. It is noteworthy that the species *C. triton*, here and elsewhere, seems to inhabit hilly country. A. B. Howell (1929) has recorded an immature specimen of this race from eighty miles west-southwest of Sianfu, Shensi. Its dark color, however, may be in part due to its immaturity. Three specimens recorded by Thomas (1911) from the Shangchow district, southeastern Shensi, may be intermediate between this and the typical race. A specimen in the British Museum from southwestern Honan is probably also this, for it is noticeably dark.

In this connection it would be interesting to know how the newly described species *Cricetulus kozhantscikovi* Vinogradov, 1927, from the Syansk Mountains on the Mongolian border of Siberia, differs from this species and other members of the "*Urocrinetus*" group. Still another name, *Cricetulus triton meihhsienensis*, has lately been given by Ho (1934a) to a supposed new race from central Shensi, the main diagnostic character of which appears to be its large size, at least as represented by the type, with a length of head and body of 185 mm.; tail, 79; greatest length of skull, 42.6. Although these measurements are large, they may indicate merely an individual of maximum size; while coming from so near the type locality of *C. t. collinus*, it seems likely that it may be the same as the latter, or perhaps an intermediate between that race and *C. t. incanus*.

Specimens examined:—Sixteen, as follows:

Shansi: Heshuin, 2.

Shensi: base of Taipai Shan, Tsingling Range, 9; forty-five miles south of Fengsiangfu, 1; Shangchow, 1 (B.M.); Shannanhsien, 2 (B.M.).

Honan: Kingtzekwan, 1 (B.M.).

Genus *Cricetiscus* Thomas

Cricetiscus Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 19, p. 456, 1917.

Mus Pallas, Reise durch versch. Provinzen d. Russ. Reichs, vol. 2, p. 703, 1773 (part).

Cricetulus Milne-Edwards, Recherches pour servir à l'Hist. Nat. des Mammifères, p. 133, 1868-74 (part).

This genus was founded by Thomas to include the small hamsters in which the color pattern is peculiar in having the white of the belly extended upward on to the side of the neck and body as a conspicuous patch before and another behind the fore shoulder, and a third and fourth in a similar manner in front of and behind the hip. In addition the tail is vestigial; the soles of the feet are densely hairy while on the hind feet the three posterior of the six normal

pads are wanting, and the three distal pads are very small. The teeth are less complicated than in *Cricetulus*, "in which there is a broad notch and commonly a deep pit between outer and inner main cusps of each lamina."

The type species is *Cricetulus campbelli* Thomas.

Although several "species" of this group have been named, they all seem to be but geographic representatives of a single one, to which Pallas in his "Reise" gave the name *Mus sungorus*, changed in his later work, "Novæ Species e Quadrupedum et Glirium Ordine," to *Mus songarus*. The only race found in the Mongolian area appears to be *Cricetiscus sungorus campbelli*.

336. *Cricetiscus sungorus campbelli* (Thomas)

Cricetulus campbelli Thomas, Ann. Mag. Nat. Hist., ser. 7, vol. 15, p. 322, 1905; Proc. Zool. Soc. London, 1908, p. 107.

Cricetiscus campbelli Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 19, p. 456, 1917.

Type specimen.—A male, skinned out from alcohol, No. 5.2.1.3, British Museum, from Shaborte, Mongolia, 42° 40' north latitude, 110° east longitude, on the southeastern edge of the Mongolian plateau.

Description.—Dorsal surface from muzzle to below the eyes and ears, and back to the root of the tail, a buffy gray, becoming nearly clear ochraceous buff at the edges of the dorsal mantle, and forming thus a broken stripe of that color, instead of the dark blackish-brown stripe found in the typical race of western Siberia. Mid-dorsal line extending from nape to root of tail, narrow and blackish brown. Exposed portions of the ear, brownish to dark brown, with a small white patch of varying size at the posterior base, or in some specimens this patch may be buffy. Tail extremely short, less than the length of the hind foot, white above and below. Lower side differing from that of typical *C. sungorus* in having the bases of the hairs gray with white tips instead of pure white to the bases; the white of the under side is continued upward in a marked and characteristic way on to the sides of the body to form four reëntnants into the dorsal mantle, one before and one behind each leg, leaving a narrow tongue of the mantle extending down on the upper portion of each limb and a broader one on the flanks.

Measurements.—The following measurements were taken by the collectors:

No.	Head and body	Tail	Hind foot	Ear	Locality
46400	103	4	14	15	Mongolia
57920	88	10	13	14	Mongolia
48379	100	10	14	14	Mongolia
84015	100	8	18	13	Mongolia
84016	88	13	14	15	Mongolia
84028	80	13	15	14	Mongolia
THOMAS (1908e)	88	14	12	13	Mongolia
THOMAS (1908e)	90	11	12	14	Mongolia

The tails are exceedingly short, and the discrepancies of the above measurements may be accounted for by differences in the method of taking the dimension of that member. Probably the shorter measurements are the more nearly correct, as the tail is a mere stump, appearing in the skins much shorter than the hind foot.

CRANIAL MEASUREMENTS OF *CRICETISCUS S. CAMPBELLI*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width outside molars	Upper cheek teeth	Lower cheek teeth	Locality
46400	24.3	22.4	12.5	13.8	11.0	4.7	3.5	3.6	Mongolia
46379	25.5	22.2	12.5	13.7	11.1	5.2	3.2	3.5	Mongolia
57920	24.5	21.5	12.6	—	10.5	5.0	3.5	3.7	Mongolia
5.2.1.3 BM (type)	23.6	20.5	11.7	—	11.0	4.7	3.6	3.5	Mongolia
5.2.1.4 BM	22.6	19.2	10.8	12.7	9.9	4.6	3.6	3.7	Mongolia
8.3.5.57 BM	23.1	20.0	11.6	11.8	10.0	4.8	3.7	3.8	Mongolia
8.3.5.54 BM	24.7	22.0	12.5	14.0	11.0	4.8	3.6	3.8	Mongolia
8.3.5.60 BM	25.2	21.9	12.9	14.3	10.5	5.0	3.6	3.7	Mongolia
8.3.5.62 BM	26.5	22.5	12.9	14.3	10.6	5.0	3.7	3.7	Mongolia
8.3.5.52 BM	25.5	22.7	12.9	14.1	10.3	5.0	3.9	3.8	Mongolia

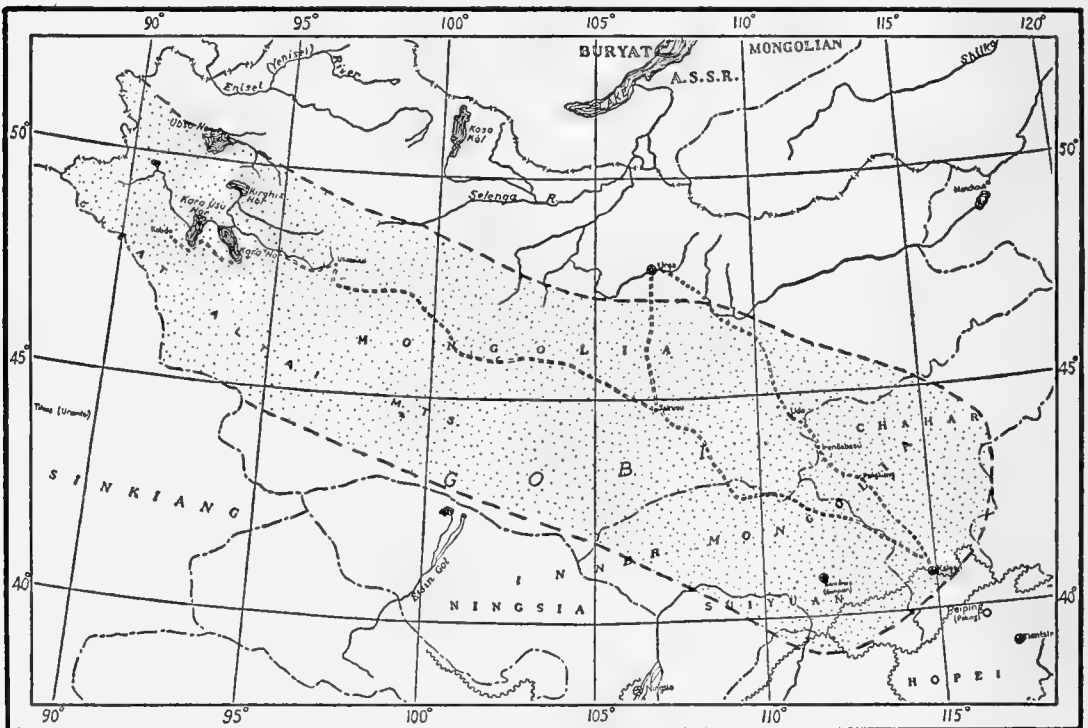


FIG. 29. Distribution Map.
Cricetiscus sungorus campbelli

Occurrence and Habits:—In the Gobi and on the Mongolian plateau, this is not an uncommon species, although it was not recorded until 1905, on the basis of specimens collected by C. W. Campbell on the edge of the desert just northwest of the Shansi border. Thomas (1908e, p. 107) later reported it as abundant along the caravan route from Kalgan to Tabool, and corrected the position of the type locality from that originally given. According to the testimony of M. P. Anderson, these dwarf hamsters incline to occupy the burrows of *Meriones*, instead of digging their own. Their habits are crepuscular and nocturnal. Dr. Andrews traced them across the plateau, obtaining specimens at stations all the way from Kalgan to sixty miles southeast of Urga. Others were taken on the Tola River, eighty miles to the westward; at Uskuk, Tuerin, northeast and southwest of Tsetsen Wang; at Tichi Ola, and at Kholobolchi Nor. No doubt their range is continuous on the westward with that of the race *crepidatus* of Hollister from the Chuisaya steppe, Siberian Altai, which differs merely in its slightly grayer coloration and somewhat darker edges to the dorsal mantle. Possibly the habitat of this hamster is different from that of the other Gobi species, for Andrews notes one taken forty miles southwest of Tsetsen Wang, on the plain among the stiff grass, at a distance from the stream bank where another species was found. The cheek-pouches of one caught one hundred and twenty miles southeast of Urga contained a number of small black seeds, and Anderson says that they live on the seeds and leaves of small plants among which they can often be seen running about in late evening.

Specimens examined:—In all, forty, as follows:

Mongolia: one hundred and forty miles southeast of Urga, 5; one hundred and twenty miles southeast, 3; eighty miles southeast, 9; sixty miles southeast, 1; eighty miles west, 1; Urga, 1; Uskuk, 2; Tuerin, 3; near Tsetsen Wang, 4; Tichi Ola, 1; Kholobolchi Nor, 3; Tabool, 4 (B.M.); no definite locality, 3, including type (B.M.).

Genus *Phodopus* Miller

Phodopus Miller, Smithsonian Misc. Coll., vol. 52, p. 498, fig. 87(b), 1910.

Cricetulus Thomas, Abstract Proc. Zool. Soc. London, December 15, 1908, p. 45; Proc. Zool. Soc. London, for 1908, p. 974, 1909 (part).

Small hamsters, with the hind feet short, broad and densely haired on the soles, without trace of the usual pads; fore feet similarly hairy-soled, but the thumb-pad is naked. Tail vestigial, not quite equaling the hind foot in length. Miller further characterized the genus as follows: "skeleton of feet shortened, but proportionate lengths of bones not specially modified; skull essentially as in *Cricetulus*, but brain-case less murine in form, unusually broad and deep in front, narrow and low behind; outer wall of infraorbital canal very short,

invisible when skull is viewed from above, its form much as in *Mesocricetus*; pattern of enamel folding more simple than in any of the other Old World Cricetinae, the salient angles opposite, the reëtrant angles of outer side of maxillary teeth not curving backward, those of inner side of mandibular teeth not curving forward." While the teeth appear to be in a somewhat unmodified condition, the reduction of the tail and the shortened hind foot with its peculiar hairy pad are indications of high specialization for desert-living.

The type species is *Cricetulus bedfordiae* Thomas.

337. ***Phodopus roborovskii*** (Satunin)

Cricetulus roborovskii Satunin, Annuaire Mus. Zool. Acad. Imp. Sci. St. Pétersbourg, vol. 7, p. 571, 1902.

Type specimen.:—The type and a second specimen doubtfully referred to the same species are in the Museum of the Academy of Sciences at Leningrad. The type locality is the upper course of the Shara Gol in extreme western Nan Shan, China. The specimens were collected by Roborovski and Kozlov in July, 1894.

Description.:—Described as pale brownish above, pure white below, with the soles of the feet thickly hairy.

The skull is said to be distinguished by having the antorbital foramen oval as seen from the front, and the interparietal is nearly an equal-sided triangle.

Measurements.:—The external measurements are given as follows: head and body, 90-102 mm.; tail, 7-6; these apparently for the two specimens mentioned, of which the first, presumably the chief basis of the description, is said to be immature.

The skull measurements are said to be: greatest length, 19 mm.; zygomatic width, 14; mastoid width, 10.8; upper cheek teeth, 3.8; lower cheek teeth, 4. These measurements, as Thomas points out, are out of proportion to those of *P. bedfordiae*, in which the skull is longer, while the head and body are markedly smaller. Possibly there is some mistake in the figures.

Occurrence and Habits.:—While the description of the color and the short tail, as well as the condition of the foot with densely hairy sole, agree with the characters of *Phodopus*, thus raising a presumption that this animal may really be identical with *P. bedfordiae*, the measurements are so different in their relative proportions that it seems best to await further information before attempting to settle the question. The only specimen certainly known is the one mentioned above from Nan Shan.

Specimens examined.:—None.

338. *Phodopus bedfordiæ* (Thomas)

DUCHESS OF BEDFORD'S DESERT HAMSTER

Cricetulus bedfordiæ Thomas, Abstract Proc. Zool. Soc. London, December 15, 1908, p. 45; Proc. Zool. Soc. London, for 1908, p. 974, 1909.

Phodopus bedfordiæ Miller, Smithsonian Misc. Coll., vol. 52, p. 498, 1910.

Type specimen.—An adult male, skin and skull, No. 9.1.1.165, British Museum, from Yulinfu, Shensi, China. Collected by M. P. Anderson and A. de C. Sowerby, May 8, 1908.

Description.—Center of the muzzle, the forehead and the face to just below the level of the eyes and ears, and the entire back as far as the root of the tail and laterally to the top of the upper arm and upper thigh, pinkish buff. Ears with their proëctote blackish, the metentote pale brown mixed with white, and the rims sometimes including more or less of the tip, white. A conspicuous white spot is present at the upper posterior corner of each eye, and a prominent tuft of pure white hair marks the outer base of the ear. The buffy hairs of the dorsal surface are slaty at their bases. Sides of the muzzle and the more ventral vibrissæ, upper lips and lower cheeks, the lower flanks, entire fore and hind limbs and tail, as well as the ventral surface, pure white to the base of the hairs.

Skull very delicate, interparietal narrow, with a slight anterior median projection. Rostrum slender, with narrow nasals. Incisors weak, their roots not making a raised welt on the surface of the premaxillaries. Upper molars decreasing in size from the first to the last, their enamel pattern consisting of three transverse rows of two cusps each in the first upper molar, and two pairs each in the two teeth following. The pairs of cusps are in a transverse row with the summits of each pair practically confluent, and a deep cross-valley between the rows.

Measurements.—This is a small species as the following measurements taken from fresh specimens show:

No.	Head and body	Tail	Hind foot	Ear	Locality
57879	76	11.0	12	12	Mongolia
84019	75	8.0	12	11	Mongolia
84020	70	7.0	10	12	Mongolia
84024	67	7.0	11	10	Mongolia
13657 MCZ	73	11.5	12	13	Shensi

CRANIAL MEASUREMENTS OF *PHODOPUS BEDFORDIÆ*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
13657 MCZ	22.5	18.5	10.7	12.5	10.6	4.5	3.3	3.1	Shensi
57879	—	—	—	12.5	—	4.5	3.2	3.2	Mongolia
9.1.1.165 BM (type)	23.7	19.3	11.0	13.1	9.7	4.5	3.7	3.7	Shensi
9.1.1.158 BM	22.9	19.4	11.4	12.8	11.0	4.5	3.7	3.2	Shensi
9.1.1.162 BM	23.8	19.9	11.6	12.8	10.5	4.6	3.4	3.7	Shensi
9.1.1.164 BM	22.6	18.6	10.5	12.1	9.5	4.4	3.1	3.2	Shensi
9.1.1.166 BM	23.0	19.2	11.1	13.0	9.8	4.6	3.4	3.7	Shensi
9.1.1.169 BM	22.6	19.0	11.5	11.7	9.5	4.6	3.7	3.3	Shensi
9.1.1.170 BM	23.1	19.8	11.6	13.0	10.6	4.6	3.7	3.7	Shensi
9.1.1.171 BM	22.0	18.5	—	11.7	9.5	4.5	3.2	3.7	Shensi
9.1.1.174 BM	21.5	17.3	10.5	11.6	10.5	4.4	3.2	3.3	Shensi

Occurrence and Habits:—This desert hamster with its back of sandy buff and its pure white under parts is a very beautiful little creature. Its extremely

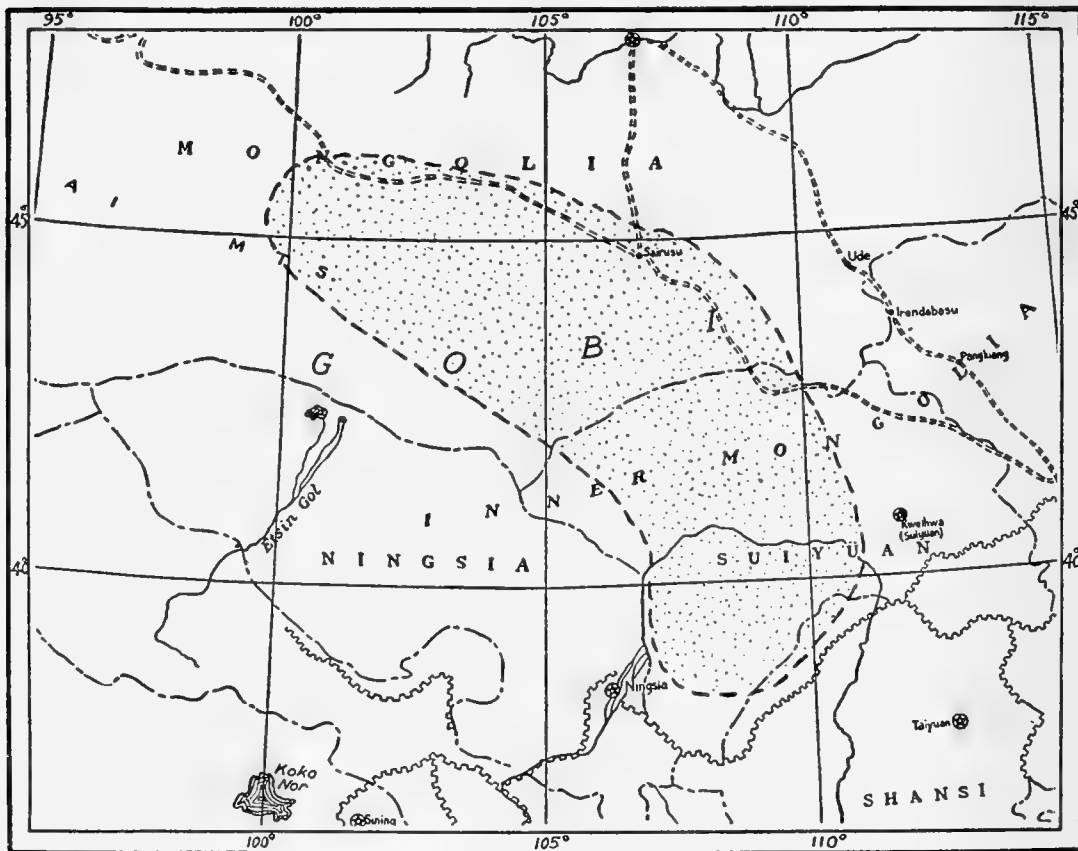


FIG. 30. Distribution Map.

Phodopus bedfordiæ

short tail, densely hairy soles, and striking coloration will at once identify it. According to its discoverers, M. P. Anderson and Arthur de C. Sowerby, it is common in the region about Yulinfu, Shensi, where it is found in the sandhills of the desert. Anderson says that they were "unable to find the burrows of these animals, and it seems probable that the shifting sand closes their entrances as soon as the animal has passed through." It will eat millet very greedily, hence the Chinese name "mai-tsang-er" (grain storer). Sowerby (1914, p. 68) writes that he and Anderson found them in the sand-dunes of the Ordos Desert, and that they made "charming pets, being very easy to keep and naturally tame. They have many amusing habits and ways. They will fill their cheek pouches to bursting point with millet or grass seed, distorting the shape of their bodies ludicrously. Then, when teased or disturbed, they will push these pouches with their fore paws, causing the grain to pour out of their mouths. They are scrupulously clean, performing elaborate toilets at frequent intervals in their play, and being of a docile disposition attempt neither to bite nor to run away." In all, these collectors secured over thirty specimens from about Yulinfu, Shensi, and a single one from Wuchai, twenty-three miles west of Ningwufu, Shansi, on a portion of the Mongolian plateau that extends into this province. Out on the Gobi, Dr. R. C. Andrews and his party found it apparently uncommon, but secured specimens at various localities, as at Tsagan Nor, Shabarakh Usu, Kholobolchi Nor, and at the east end of Lan Shan, from one to three specimens only at each place.

Specimens examined:—In all, eighteen, as follows:

China:

Shensi: Yulinfu, 1 (M.C.Z.); 9, including type (B.M.).

Mongolia:

Tsagan Nor, 3; Shabarakh Usu, 2; Kholobolchi Nor, 1; east end of Lan Shan, 1; one hundred and sixty miles southeast of Sair Usu, 1.

Genus *Cansumys* G. M. Allen

Cansumys G. M. Allen, Journ. Mammalogy, vol. 9, p. 244, 1928.

The only known species and type of the genus (*C. canus*) is about the size of the larger species of *Cricetulus*, with a tail about half the length of head and body, shaggy, and well clothed with long hair, thus very different from such species as *Cricetulus triton* in which the scales of the tail may still be traced through the thin coat of very short hairs. Feet small and slender with proportionally long fore toes; hind foot with only the proximal third of the sole hairy, the distal portion with six pads, of which the two plantar are small and oval, while of those under the toes the two central are smaller and closely approximated while the two outer are larger and more distinct. Claws white,

that of the first digit of the hind foot short, not projecting beyond the pad, and slightly flattened, almost nail-like, the first hind digit itself short, reaching the tip of the metatarsal of digit 2.

The skull has the dorsal profile evenly convex upward; the audital bullæ are large, rounded, projecting well below the level of the palate and so closely approximated in front that the least distance between them is less than the width of the interpterygoid fossa. Antorbital plate weakly developed and slightly emarginate as in *Cricetulus*; the interparietal is broad and strap-shaped rather than triangular and small. Raised supraorbital ridges prominent, commencing at the proximal ends of the nasals and diverging regularly backward following the general boundaries of the lateral edge of the parietals. Rostrum proportionately longer than in *Cricetulus*, with long, narrow, incisive foramina from which well-marked grooves continue to the posterior arched border of the palate. A prominent raised ridge marks the course of the upper incisor root on the premaxillary.

Tooth rows diverging slightly in front. The anterior upper molar consists of the usual three pairs of cusps in transverse rows, with a notch in the median line in front. The second and third molars are subequal in size, and consist each of two pairs of cusps, of which the inner is more or less crescentic in crown view with the anterior horn of each crescent projecting outward in front of the corresponding outer cusp. The valley between the pairs of cusps in the anterior half of the two last molars is represented in worn teeth by an elliptical or sausage-shaped enamel lake, the long axis of which is distinctly turned outward in front; further wear may reduce this to two small nearly circular islands of enamel.

The type and only known species is *Cansumys canus* G. M. Allen.

339. ***Cansumys canus* G. M. Allen**

GRAY LONG-TAILED HAMSTER

Cansumys canus G. M. Allen, Journ. Mammalogy, vol. 9, p. 245, 1928.

Type specimen.—An adult female, skin and skull, No. 23779, Museum of Comparative Zoölogy, from Choni, southern Kansu, China. Collected December 9, 1925, by Robert B. Ekvall.

Description.—Dorsal surface of the body and tail a general hoary gray. The hair of the middle of the back is about 15 mm. long, of which the basal 12 mm. is slaty gray, and the tip whitish. Interspersed are numerous all-black hairs slightly darkening the central area of the back, while on the sides is a very faint wash of buffy. The backs of the feet, a narrow median area from the chin to the chest, a conspicuous spot on each side of the muzzle at the base of the vibrissæ, and another at the outer base of each ear are pure white to

the roots of the hairs. Elsewhere on the ventral surface of the body the fur is slaty gray at the base, broadly tipped with whitish, and the lower side of the tail is very slightly paler than the upper side. The outer surface of the low rounded ears is covered with short, dark-brown hairs, the inner surface (metectote) with blackish hairs. The shaggy hair of the tail is about 10 mm. long at the base and about 7 mm. near the tip.

The characters of the skull and teeth have been mentioned in the generic description.

Measurements:—The collector's measurements are: (type) total length, 9.75 inches (248 mm.); tail, 4.25 inches (108 mm.). The hind foot, in the dried skin, measures about 20.4 mm.

The skull of the type measures: greatest length, —; basal length, 31.7 mm.; palatal length, 18.8; zygomatic width, 18; width of brain case, 13.8; length of bulla, 8.0; distance between bullæ, 1.0; width outside molars, 7.1; diastema, 9.2; length of incisive foramina, 7.0; upper cheek teeth, 6.6; lower cheek teeth, 6.6; mandible, condyle to base of incisor, 21.6.

Occurrence and Habits:—This interesting cricetine, lately discovered in Kansu, is as yet known from the type locality only, Choni, in the southern part. Nothing is known of the habits or peculiarities of the animal, although its slender, delicate feet, and relatively long and shaggy-haired tail give it the appearance of a tree-living mammal, a supposition further strengthened by the almost nail-like claw of the first hind toe. In its cranial characters it is widely different from other eastern relatives, combining some of the features of *Cricetus* with other peculiar characters of its own. The relationship to *Cricetulus* is apparently not very close.

Specimens examined:—Two only, the type and a topotype (immature), from Choni, Kansu (M.C.Z.).

Subfamily GERBILLINÆ

GERBILS

Gerbils are typically desert mammals, living in burrows which they excavate in sandy areas. Their hind feet are somewhat elongate for saltatorial progression, but the hind legs are not so noticeably lengthened as they are in the jerboas. The jumping habit seems to be correlated with more or less inflation of the audital bullæ, either for greater ease in detecting minute sounds in open desert country, or for a certain aid in balance while in active motion. The teeth are higher-crowned than in the Cricetinae, with their summits flat instead of tubercular, and their loop-like cusps arranged in opposite pairs. Of these pairs there are three in the anteriormost tooth of the maxillary series,

and two in the second, forming a figure-8 pattern. Three genera are known from the area here treated and include but five species, the obvious distinguishing characters of which may be keyed as follows:

KEY TO THE GENERA AND SPECIES OF CHINESE AND MONGOLIAN GERBILLINÆ

- A. Size larger; head and body more than 150 mm., greatest length of skull 40 mm. or more.
 - a. Last upper molar nearly oval or rounded in section, without a distinct infold of enamel from inner or outer side. *Meriones tamaricinus satschouensis*
 - b. Last upper molar with a slight reëntrant fold of enamel near the middle of inner and one near middle of outer side, more or less cutting off a posterior lobe *Rhombomys opimus nigrescens*
- B. Size smaller; head and body less than 150 mm., greatest length of skull less than 40 mm.
 - a. Ear normal, about half the length of the hind foot (with claws).
 - 1. Hair of the under surface white with gray bases *Meriones unguiculatus*
 - 2. Hair of the under surface white to the roots. *M. meridianus psammophilus*
 - b. Ear much reduced, about a third the length of hind foot (with claws). *Brachiones przewalskii callichrous*

Genus **Meriones** Illiger

Meriones Illiger, Prodrum Syst. Mamm. et Avium, p. 82, 1811.

Gerbillus Milne-Edwards, Ann. des Sci. Nat., Zool., ser. 5, vol. 7, p. 377, 1867 (part).

Pallasiomys Heptner, Zeitschr. f. Säugetierk., vol. 8, p. 150, 1933.

In external form the members of this genus are rat-like, with ears well developed, but rather narrow, the tail about equal to the body length, the hind limbs and feet very slightly elongated for saltatorial progress. The skull has the hinder end enlarged, the bullæ more or less swollen as in many jumping mammals, with a resulting contraction of the interparietal from side to side. The anterior root of the zygoma is much broader than the middle portion. The upper incisors have a narrow groove on their anterior face. The molars are three in number above and below on each side, the anteriormost above with two inner and two outer enamel folds which extend about half-way across the crown of the tooth, and are almost exactly opposite, so as to meet in the middle. There are thus three transverse lozenge-shaped divisions marked off. The second molar is shorter, with a single enamel reëntrant on each side, giving a figure-8 pattern to the crown, with the anterior lobe the larger. The last molar is still smaller, and nearly elliptical in its transverse axis. The pattern of the lower molars is essentially the same.

In a recent paper, Heptner (1933) has selected Illiger's *M. tamaricinus* as the type of the genus, and erects *Pallasiomys* (type species, *Gerbillus ery-*

throuurus Gray) for those species with inflated bullæ, although he includes *M. unguiculatus* as an exception to this condition. Since the degree of inflation varies in different species and does not otherwise greatly modify the shape of the skull, its importance as a generic character by itself is lessened. Perhaps the best course would be to retain the name in a subgeneric sense.

340. *Meriones unguiculatus* (Milne-Edwards)

Gerbillus unguiculatus Milne-Edwards, Ann. des Sci. Nat., Zool., ser. 5, vol. 7, p. 377, 1867; Recherches pour servir à l'Hist. Nat. des Mammifères, p. 142, pl. 10A, figs. 2-2e; pl. 11, figs. 1, 2, 1868-74.

Gerbillus kozlovi Satunin, Annuaire Mus. Zool. Acad. Imp. Sci. St. Pétersbourg, vol. 7, p. 553, 1902.

Meriones unguiculatus Thomas, Proc. Zool. Soc. London, 1908, p. 106.

Meriones kurauchii chihfengensis Mori, Rept. First Sci. Exped. to Manchoukuo, sect. 5, div. 2, pt. 4, p. 71 (English), pls. 11, 12, text figs. 18, 19, March, 1939. Chihfeng, Jehol.

Type specimens:—No type was named by the describer. The original specimens, however, appear to have been several in number, and were sent to the Muséum d'Histoire Naturelle at Paris by Père Armand David from "la Mongolie chinoise," perhaps from what is now Saratsi, northwestern Shansi, China, where he stayed.

Description:—Ears prominent but narrow, tail slightly less than length of head and body, hind limbs not markedly elongate. General color of the mid-dorsal area from muzzle to tail a ruddy buff, about "ochraceous buff" of Ridgway, paling on the sides of the body to "buff." The individual hairs are slaty gray at the base with a broad ochraceous-buff band terminally, or there may be a minute black tip. Scattered amongst these hairs are others wholly black, which very slightly darken the general tone. An indistinct buffy-white ring surrounds the eye and is extended back to the base of the ear. The ear has the proëctote buffy, with a short fringe of whitish hairs along the rim; the inner part of the ear is nearly naked except for a few very short whitish to buffy hairs near the tip. Tail ochraceous all around, with a mixture of black hair on the distal half above. Backs of the feet pale buffy. Lower lips, chin and upper throat, and the inner sides of the fore legs, pure white to the bases of the hairs, with sometimes a faint buffy wash in the center of the upper chest. Rest of the under parts white with prominent gray bases to the hairs.

In the skull the nasals are narrow and slightly shorter than the ascending branches of the premaxillaries. The edges of the orbits slightly overhang. The interparietal has a generally oval form, the posterior border convex backward, but the anterior border, where it is in contact with the parietals, forms a slightly angular outline with the point forward. The audital bullæ are inflated posteriorly, and the meatus is also somewhat swollen but does not reach the angle of the zygomatic arch. The large size of the bullæ results in a narrowing of the basioccipital and an approximation of the anterior ends of the bullæ

until they are only about 1.5 mm. apart. The upper incisors have the longitudinal groove well marked and slightly external to the middle of the tooth.

Measurements.—Measurements of a large series do not show any appreciable difference in size between the sexes. The following are from fresh specimens made in the field by the collector:

No.	Head and body	Tail	Hind foot	Ear	Sex	Locality
45411	125	95	28	15	♀	Shansi
45414	125	93	30	14	♂	Shansi
45415	120	94	28	15	♂	Shansi
45422	130	90	30	14	♂	Shansi
59331	114	100	27	13	♀	Shansi
59360	127	104	32	14	♀	Mongolia
59368	132	100	32	15	♂	Mongolia
59371	130	104	32	13	♀	Mongolia
59387	125	105	29	13	♂	Mongolia
59402	127	100	31	14	♂	Mongolia

CRANIAL MEASUREMENTS OF *MERIONES UNGUICULATUS*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
59333	33.9	29.2	17.7	19.6	18.9	6.8	4.3	4.6	Shansi
59341	34.1	29.6	18.2	18.2	18.5	7.0	4.8	4.7	Shansi
59368	34.6	29.5	17.5	19.5	18.8	7.0	5.0	4.8	Mongolia
59628	35.2	29.5	17.6	19.3	18.8	6.9	4.8	4.7	Mongolia
59631	35.8	30.5	18.8	20.3	19.6	7.0	4.7	4.8	Mongolia

Occurrence and Habits.—This is one of the most abundant small mammals of China and Mongolia, easily distinguished from other members of the genus occurring in the same regions by its gray-based belly hairs and dark brown instead of whitish claws. M. P. Anderson, who with Sowerby collected a series for the British Museum, noted that they are to some extent diurnal, though most often seen between sunset and dark, "when they sit spermophile-like before their burrows. I frequently succeeded in approaching within about eight feet of a sitting individual, during which manoeuvre the animal would eye me steadily and, finally, with one rapid move, plunge into his hole, but reappear after a few moments if I remained perfectly still." He speaks of a curious noise they make in their burrows, "very much like the distant galloping of a horse on a hard road." At Uskuk, Loh, and Tsagan Nor, Dr. Andrews caught specimens at all times during the day, indicating the diurnal habits of these animals. They were abundant at these localities, as also at Kweihwacheng, Shansi, where they were found living out on low plains.

The range extends into northern Kansu, whence Buechner has recorded it, while to the northward it reaches Transbaikalia, and on the east extends probably to the edge of the Mongolian plateau.

According to David, it lives in colonies, and lays up stores of seed in its burrows in which it hibernates.

Although Satunin (1902) distinguished as *Gerbillus kozlovi* specimens of this species from the lower Kobdo and Chaljun Gol, Gobi Altai, on the ground of clearer white below, without the yellowish wash sometimes found in *M. unguiculatus*, the difference does not seem enough to warrant the recognition of a separate subspecies from western Mongolia. Probably this and the nearly oval shape of the interparietal are characters subject to much variation. Apparently, also, Mori's recently named *Meriones kurauchii chihfengensis* from Chihfeng, central Jehol, is a specimen of this same species.

Specimens examined:—In all, two hundred and sixty-nine, as follows:

China:

Shansi: Kweihwacheng, 35; Maitaichao, 22.

Mongolia:

Artsa Bogdo, 8; Baron Sog-in-Sumu, 3; Gun Burte, 4; Kholobolchi Nor, 13; east end of Lan Shan, 2; Iren Dabasu, 4; Loh, 26; Orok Nor, 7; Shabarakh Usu, 3; fifty miles west of Sair Usu, 4; Tsagan Nor, 99; Ula Usu, 9; Uskuk, 28; no locality, 2.

341. *Meriones tamaricinus satschouensis* (Satunin)

Gerbillus tamaricinus satschouensis Satunin, Annuaire Mus. Zool. Acad. Imp. Sci. St. Pétersbourg, vol. 7, p. 555, 1902.

Meriones tamaricinus satschouensis Trouessart, Cat. Mamm. Viv. Foss., p. 359, 1904.

Type specimen:—A female, skin and skull (number not given), in the Zoological Museum of the Academy of Sciences at Leningrad, U. S. S. R., from the oasis Sachow in extreme western Kansu, China. Collected July 30, 1895, by the expedition of Roborovski and Kozlov.

Description:—This large gerbil differs from the typical *M. tamaricinus* of the western part of Siberia in its shorter ears, paler color, and shorter, broader skull. It is described as pale reddish ochraceous above, finely and delicately lined with black. The hairs of the back have the basal three-fourths slaty gray, then a reddish-ochraceous ring and a minute black tip; in many hairs, however, the tip is white. Anterior vibrissæ white, the others black. The lips, the cheeks to the eyes, and a band from the eye to the ear, white. Ears like the back, but their rims white. Sides paler than the back, pale brownish yellow, sharply marked off from the white of the under side. Under parts white to the roots of the hairs. Tail bicolor, dark brown above, edged with reddish ochraceous; pure white below.

Measurements.:—No measurements accompanied the type specimen.

The skull, which is said to be shorter and broader than in the typical race, measured: basilar length, 32.5 mm.; occipital (i.e., greatest) length, 42; zygomatic width, 28; mastoid width, 23.2; length of nasals, 18; upper cheek teeth, 5.5.

Occurrence and Habits.:—This gerbil is known from the type only, taken in extreme western Kansu at the oasis Sachow, a locality which may mark nearly the eastern limit of the species' range. The typical race is found in south-eastern Russia and the Trans-Caspian region, so that its extension to the western edge of China is interesting.

Specimens examined.:—None.

342. *Meriones meridianus psammophilus* (Milne-Edwards)

Gerbillus psammophilus Milne-Edwards, Recherches pour servir à l'Hist. Nat. des Mammifères, p. 144, pl. 10A, figs. 1-1e, 1868-74.

Gerbillus brevicaudatus Milne-Edwards, Ann. des Sci. Nat., Zool., ser. 5, vol. 7, p. 377, 1867 (not of F. Cuvier).

Gerbillus roborowskii Buechner, Wiss. Resultate d. v. Przewalski Reisen, vol. 1, Säugethiere, pl. 5, figs. 1-10, 1888; p. 63, pl. 6, fig. 3, 1889. Nomochun Gol, Tsaidam.

Meriones psammophilus Thomas, Proc. Zool. Soc. London, 1908, p. 640; *ibid.*, for 1908, p. 972, 1909.

Meriones auceps Thomas, Proc. Zool. Soc. London, 1908, p. 640. Taiyuanfu, Shansi.

Gerbillus urianchanicus Vinogradov, Yearbook Govt. Mus. Minussinsk, vol. 5, p. 41, 1927. Ikiottuk, Uriankhai, northern Mongolia.

Type specimen.:—Milne-Edwards based this name on specimens sent to the Paris Museum by Père Armand David from "la Mongolie et à Suen-hoa-fou, dans le province de Pékin," that is, Hopei. No type was mentioned, but the type locality may be taken as Suanhwafu, where David resided for some time.

Description.:—In general appearance this species and *M. unguiculatus* are remarkably similar, but may be distinguished at once by the fact that the present species is a ruddier tone above, with bright ochraceous tail, white instead of dark-brown claws, and with the bases of the hairs of the lower surface pure white instead of slaty gray. The general color of the dorsal surface from the muzzle to the root of the tail is ochraceous buff, sparingly lined with all-black hairs; on the flanks the color pales to buff and the same tint extends in a narrow line along the upper side of the arm and hind leg. The tail is clear ochraceous buff above, slightly paler below, or more or less of the under side of the tail may be pure white, and there may be a number of black hairs at the tip of the tail forming a blackish pencil, but these variations seem to have no geographical significance. The under surface of the head, body and limbs, as well as the upper side of the hands and feet, is pure white to the roots of the hairs. An ill-defined pale spot is present above and behind the eye, extending to the base of the ear, with a second whitish area just behind the ear; cheeks

buffy white. Ears externally like the back, with a fringe of longer pale-buff hairs along the front edge. Lower vibrissæ white, upper ones black.

The skull is readily distinguished from that of *M. unguiculatus* by its more swollen bullæ, in which the meatus is so inflated as nearly or quite to touch the squamosal angle of the zygomatic arch. The shape of the interparietal differs in having the anterior border slightly convex forward instead of angular, while the posterior border is more convex posteriorly, giving to the bone the shape of a lens flatter on the front than on the back. The nasals of *M. m. psammophilus* are narrower in front, and in the palate the incisive foramina are longer, extending back quite to the level of the tooth row.

Measurements.—A splendid series of skins collected by the Central Asiatic Expeditions furnishes the following measurements as taken by the collectors in the field:

No.	Head and body	Tail	Hind foot	Ear	Sex	Locality
59353	119	110	30	15	♂	Mongolia
59355	120	95	32	14	♂	Mongolia
59358	115	100	32	14	♂	Mongolia
59370	128	102	34	15	♂	Mongolia
59376	130	100	33	14	♂	Mongolia
59362	120	100	32	13	♀	Mongolia
59366	118	105	32	13	♀	Mongolia
59429	125	100	32	14	♀	Mongolia
59438	115	102	29	15	♀	Mongolia
59453	115	100	33	13	♀	Mongolia

While there is probably little appreciable difference between the sexes in the matter of size, it seems from a large series of measurements that the males attain to slightly greater lengths, for the maximum sizes represented are of that sex. Milne-Edwards gives rather too short a tail length, namely, 75 mm., with head and body 125, but perhaps his specimen was shrunken in alcohol.

CRANIAL MEASUREMENTS OF *MERIONES MERIDIANUS PSAMMOPHILUS*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
84033	35.5	30.0	18.7	19.7	20.0	7.0	5.3	5.0	Mongolia
84035	36.0	30.1	18.3	19.5	20.1	7.0	5.0	5.0	Mongolia
84048	37.2	31.3	19.2	20.0	20.8	7.1	5.3	5.0	Mongolia
84051	36.5	31.3	19.4	19.3	20.0	7.1	5.0	5.0	Mongolia
84099	36.8	31.2	19.1	20.0	20.0	7.3	4.9	4.9	Mongolia
84050	33.7	28.0	17.2	19.0	19.7	7.0	4.8	4.8	Mongolia
84077	34.1	28.8	17.6	18.1	19.8	7.0	4.6	5.0	Mongolia
84049	34.6	29.0	17.8	18.8	19.7	6.8	4.7	4.8	Mongolia
59458	35.0	29.7	17.6	18.7	19.9	6.7	4.9	4.8	Mongolia
23970 MCZ	36.7	31.0	19.5	19.5	20.5	7.0	4.6	4.8	Mongolia

Nomenclature:—The Mongolian race of this gerbil is undoubtedly a close ally of the typical *Meriones meridianus* of the steppes of western Siberia. This desert-living subspecies was first described, apparently, by Milne-Edwards as *Gerbillus brevicaudatus*, but since this name was preoccupied through its prior use by Cuvier, Milne-Edwards shortly changed it to *G. psammophilus*. Apparently Buechner's *Gerbillus roborowskii* based on seven specimens collected by Przewalski in Tsaidam, Nomochun Gol, somewhat west of the western border of Nan Shan, is quite the same; at least I find no characters to separate specimens from western Mongolia, so identified by Professor B. Vinogradov of the Academy of Sciences at Leningrad to whom Buechner's material was available. Twenty years later Thomas named *Meriones auceps* from Taiyuanfu, Shansi, supposing that it was larger than the species described by Milne-Edwards, though otherwise exactly like it. Indeed he suggested that the latter's original series consisted of the two species confused under the one name. Having lately had the privilege of examining the series studied by Thomas at the British Museum, it now becomes evident that he was misled by the fact that the three specimens he had regarded as identical with those lent from Milne-Edwards's original lot were by a curious coincidence all immature and of very nearly the same age, hence smaller than the adults from Taiyuanfu with which he compared them. Their immaturity is indicated not only by the condition of the bones of the skulls but by the fact that specimens of intermediate size and age connect the extremes of size in the series. There is no doubt whatever therefore that *M. auceps* is a synonym of *M. m. psammophilus*. I have also ventured to include as a later synonym the *Gerbillus urianchanicus* described in 1927 by Vinogradov as similar to *G. roborowskii* but with larger bullæ. The type came from Ikiottuk, Uriankhai, northern Mongolia, and is said to be a skin and skull in the Minussinsk Museum. In view of the wide area in Mongolia covered by *M. m. psammophilus*, and the range of variation in the size of the ear bullæ, it seems best to await further confirmation of the importance of the supposed characters of the northern animal.

Occurrence and Habits:—Throughout the Gobi and its extension into Shansi and Shensi, this seems to be a common species. It is nocturnal in habits in contrast to the diurnal *M. unguiculatus*, and lives in colonies usually, preferring bushy country, where in patches of thorn scrub or other protection its burrows may be found (Sowerby). In Shansi Sowerby found it common even farther south than Taiyuanfu. In Shensi Thomas (1909, p. 971) records that Anderson secured numerous specimens about Yenanku on the Ordos Desert north of Chingpien, as well as in Shansi at Paotehchow and north of Kolanchow. It was abundant in the farm fields and grasslands north of Chingpien. The Central Asiatic Expeditions under Dr. R. C. Andrews secured it at

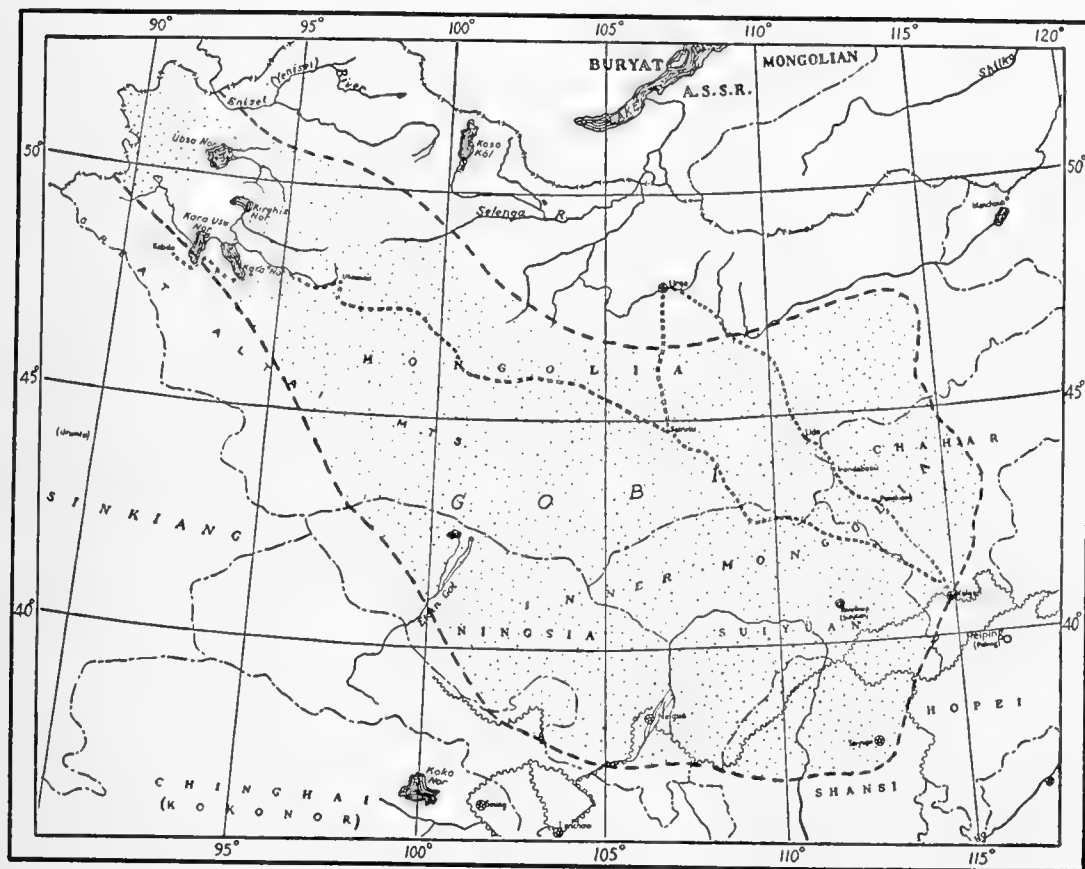


FIG. 31. Distribution Map.
Meriones meridianus psammophilus

Maitaichao, east of Paotow, Shansi, and at various localities to the westward in the central Gobi, as at Tsagan Nor, Iren Dabasu, Loh, Artsa Bogdo, Orok Nor, and Shabarakh Usu. Here it was often found in the same localities with *M. unguiculatus*.

Specimens examined:—In all, two hundred and forty-four, as follows:

Mongolia:

Artsa Bogdo, 26; Bailing Imad, 1; Kholobolchi Nor, 3; Ikhe Bologai, 2; Iren Dabasu, 21; east end of Lan Shan, 4; Loh, 11; Orok Nor, 7; Sair Usu, 2; one hundred and sixty miles southeast of Sair Usu, 2; Shabarakh Usu, 1; Tsagan Nor, 114; forty-five miles east of Tsagan Nor, 6; Tuerin, 5; no exact locality, 5.

China:

Shansi: Maitaichao, east of Paotow, 2; twelve miles north of Kolanchow, 2 (B.M.); Ningwufu, 1 (B.M.); Paotehchow, 5 (B.M.); Taiyuanfu, 3 (B.M.), 3 (U.S.N.M.); Wutsi, 1 (U.S.N.M.).

Shensi: Yeninfu, 11 (B.M.), 2 (U.S.N.M.); Ordos Desert north of Chingpien, 2 (B.M.); Yulinfu, 2 (U.S.N.M.).

Genus *Brachiones* Thomas

Brachiones Thomas, Ann. Mag. Nat. Hist., ser. 9, vol. 16, p. 548, November, 1925.
Gerbillus in part, of authors.

This genus was erected to contain the aberrant *Gerbillus przewalskii* Buechner, a desert-living species which has become modified more than other genera for a subterranean life, through the shortening of the tail, great reduction in size of the ears, and slight enlargement of the claws of the fore feet for burrowing. As pointed out by Thomas, "the skull is very different from that of *Meriones* both in general shape and in various details. It is short and broad, with a peculiarly short conical muzzle, short and narrow nasals, and a very broad anteorbital region, which is sharply angular but without beads. Palatal foramina are comparatively short and the posterior pair minute. The parapterygoid fossæ are small, and the little plate which in *Meriones* partially roofs them in anteriorly is reduced in *Brachiones* almost to nil. Bullæ are smaller in proportion than in *Meriones*. Incisors orthodont, as contrasted with the markedly opisthodont incisors of *Meriones*."

Originally discovered by Przewalski in the Lob Nor region of Turkestan, this gerbil is found to have a wide range in the central Asiatic deserts, and in recent years has been found to enter the Gobi in its southwestern part, whence Heptner has described the following race.

343. *Brachiones przewalskii callichrous* Heptner

GOBI SHORT-EARED GERBIL

Brachiones przewalskii callichrous Heptner, Ann. Mus. Zool. Polonici, vol. 11, no. 2, p. 15, January 30, 1935.

Type specimen.—The type is an adult male, No. 459—1926 (58) in the Zoological Museum of the University of Moscow, collected April 3, 1926, near Sogo Nor, lower part of the Etsin Gol, Gobi, "in der Nähe des 41° 50' n. Br., 99° 45' östl. L. v. Gr."

Description.—Somewhat paler than the typical race, nearly dust color above, or very pale grayish yellow, finely but rather strongly sprinkled with blackish hairs. Tail almost white, slender and tapering to a point instead of ending in a tuft. Sides of the face, the backs of the feet, and the entire lower surfaces pure white to the roots of the hairs. Soles of the hind feet densely hairy, but the palms of the fore feet naked.

The skull is said to be slightly larger than in the typical race.

Measurements.—The following measurements of an adult female are given by the describer: head and body, 86.2 mm.; tail vertebræ, 77.6; hind foot with-

out claws, 23.9; ear, 9. The skull of the type measured: greatest length, 29.2 mm.; condylobasal length, 27.4; zygomatic width, 17.8; interorbital width, 6.7; upper cheek teeth, 3.9.

Occurrence and Habits.—The extremely reduced ears, which barely project as a short rim above the head, the long fore claws, and the shortened tail all proclaim the burrowing habit of this small gerbil, while the pale color, pure white under side, and hairy soles go with sand-dwelling. The animal has not been recorded except from the southwestern Gobi.

Specimens examined.—None.

Genus *Rhombomys* Wagner

Rhombomys Wagner, Gelehrte Anz. Koenig. Bayer. Akad. Wiss., Muenchen, vol. 12, no. 52, p. 421, 1841.

Gerbillus Buechner, Bull. Acad. Imp. Sci. St. Pétersbourg, vol. 34 (new ser., vol. 2), p. 112 (Mélanges Biol., vol. 13, p. 158), 1892.

This genus is very close to *Meriones*, differing chiefly in having the last upper molar more or less distinctly bilobed. This is due to a slight infolding of enamel about in the middle of the length, and extending only a short distance in from the edge. The inner fold is better marked than the outer which may be nearly lacking. In other respects the teeth in *Rhombomys* are essentially as in *Meriones*, the first molar consisting of three, the second of two transverse enamel loops formed by rounded infolds of the enamel, meeting similar re-entrants in the middle of each tooth. In correlation with the large size, the skull is bigger and heavier in proportion than in the species of *Meriones* examined, with heavy and slightly overhanging lines of beading over the orbits that end in well-marked postorbital projections at the outer corners of the parietals, and then continue backward as somewhat converging raised lines to the lambdoid ridges just external to the interparietal. The latter is very nearly elliptical in outline, and the prominent lambdoid ridges end abruptly at its outer border. The incisors of the upper jaw have a deep groove on the outer third and a second much less plainly marked groove near the extreme inner border of the tooth. The auditory meatus is not inflated anteriorly.

Two subspecies have been recognized in the desert country of Mongolia and extreme western Kansu, but it is still somewhat uncertain whether they differ very much. One of these, *R. opimus giganteus*, is apparently slightly darker than the other, *R. o. nigrescens*, and since most of the type series was from Dzungaria (near Ebi Nor), that may be regarded as the type locality, while *R. o. nigrescens* is probably slightly paler and is the Gobi race. The type of the genus is *Rhombomys pallidus* of southeastern U. S. S. R.

344. *Rhombomys opimus nigrescens* (Satunin)

Gerbillus opimus nigrescens Satunin, Annuaire Mus. Zool. Acad. Imp. Sci. St. Pétersbourg, vol. 7, p. 560, 1902.

Gerbillus opimus Buechner, Wiss. Resultate d. v. Przewalski Reisen, vol. 1, Säugethiere, p. 69, pl. 7, fig. 2; pl. 8, figs. 6-12, 1889.

Gerbillus giganteus Buechner, *ibid.*, p. 73, pl. 7, fig. 1; pl. 8, figs. 13-20, 1889 (in part, as to Gobi specimen).

Rhombomys opimus alaschanicus Matschie, in K. Futterer, Durch Asien, vol. 3, chap. 5, Zool., Nachtrag, p. 12, 1911. Alashan.

Type specimens.—The three cotypes, females, upon which the race is founded were from Orok Nor in the Gobi Altai, collected in October, 1899, by the Kozlov Expedition. They are presumably in the Zoological Museum of the Academy of Sciences at Leningrad, U. S. S. R.

Description.—Forehead from muzzle back between eyes and ears to nape, and the mid-dorsal region, ochraceous buff, slightly paler over the shoulders but brightest over the rump, and extending down on to the outer surface of the hind legs. Flanks and sides of the head and neck buff. Scattered fine black hairs are evenly sprinkled over the dorsal side of the body. Backs of the feet buff, the claws blackish brown. Ears shorter than in *Meriones*, their outer side clothed with very short buffy hair. Chin and lower lips pure white; the rest of the under parts whitish with slaty bases to the hairs. In the specimens at hand the belly and hairy soles of the hind feet are more or less stained with reddish earth. Tail in the midline above, ochraceous paling to buffy on the sides and under surface. On the terminal third of the tail above, blackish hairs come in, and increase in number distally to form a slight crest. Vibrissæ mostly white, with a few of the dorsal ones black.

The heavy, ridged skull is strikingly different from that of the species of *Meriones* with which this gerbil is associated in life. The parietal region is much flatter, the brow ridges heavier. In the anterior portion of the zygomatic root the dorsal surface is actually as well as relatively much narrower than in that genus. There is a considerable variation in the development of the posterior lobe of the last upper molar, some having it well marked off, others with only the inner reëntrant present.

Measurements.—The following measurements were taken by the collectors from fresh specimens:

No.	Head and body	Tail	Hind foot	Ear	Sex	Locality
59499	165	143	42	13	♂	Mongolia
59524	160	145	43	14	♀	Mongolia
59703	168	160	47	13	♂	Mongolia
59705	170	148	45	15	♂	Mongolia
84055	170	145	43	11	♀	Mongolia
84069	165	135	46	12	♀	Mongolia
84070	160	145	45	11	♀	Mongolia
84073	170	130	47	13	♂	Mongolia

CRANIAL MEASUREMENTS OF *RHOMBOMYS*

No.	Greatest length	Basal length	Palatal length	Zygom- atic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Sex	Locality
84055	43.6	39.0	24.6	26.0	23.4	8.7	7.6	8.2	♂	Mongolia
84061	45.0	39.0	25.5	(25.0)	23.7	8.6	7.8	8.0	♂	Mongolia
84064	43.5	38.0	24.0	(26.0)	23.5	9.0	7.6	8.3	♂	Mongolia
84065	43.0	38.5	25.6	25.0	23.0	8.3	7.2	7.6	♂	Mongolia
84074	41.5	36.0	22.8	24.0	22.0	8.0	7.1	7.8	♂	Mongolia
84056	42.7	38.0	24.0	26.0	23.9	8.0	7.5	7.9	♀	Mongolia
84059	42.6	36.7	23.0	25.0	23.6	8.2	7.3	7.5	♀	Mongolia
84060	43.0	38.4	23.8	25.0	22.5	8.0	7.8	7.8	♀	Mongolia
84070	44.0	37.6	23.6	25.3	23.6	8.2	7.4	8.0	♀	Mongolia
84072	41.8	36.0	23.0	24.8	—	8.0	7.2	7.9	♀	Mongolia

Occurrence and Habits:—There is some doubt as to the distinction of this Gobi race from *R. opimus giganteus*, in which there seems to be more black in the tail, although the size is not very different as shown by Buechner's figures of the skulls of both. Until more thorough comparisons can be made, however, it seems best to recognize it.

Dr. R. C. Andrews and Dr. Walter Granger found it common at about ten miles north of Tsagan Nor, as well as at Shabarakh Usu in the Gobi, and secured a single specimen at Iren Dabasu, but did not meet with it elsewhere. At the locality first mentioned, Dr. Andrews notes that it was first found in a dry river valley covered with a scrub growth of tamarisk, most of it from three to five feet in height. The animals live in colonies, burrowing in the sand hummocks scattered about among the scrub, and make large holes. They are diurnal in habits, so that practically all the series were secured by shooting.

Although the Central Asiatic Expeditions did not meet with it elsewhere, Satunin has recorded it from the type locality, Orok Nor, and Buechner (1892, p. 158) mentions that Potanin collected one in October, 1884, in Chuanche vale, Kansu, between Zsinyuan and Lanchow. In his account of the mammals secured by the Przewalski Expedition, Buechner has further recorded a series from Alashan, referring them to typical *R. opimus*, the same that Matschie afterward named as a new race, *R. o. alaschanicus*. No doubt all these records have, however, to do with a single form, the range of which is perhaps more or less coëxtensive with that of the tamarisk.

Specimens examined:—The following thirty-six:

Mongolia: Iren Dabasu, 1; Tsagan Nor, 13; Shabarakh Usu, 22.

Subfamily MICROTINÆ

LEMMINGS AND VOLES

In this group, which includes the voles and lemmings, nearly all are essentially ground-living in habits, making runways in swamps and meadows,

some species tunneling extensively along the ground and at shallow depths. In general the body is rather stout, the limbs and tail short. The enamel pattern of the molars is characterized by the many reëntrant angles from opposite sides of the tooth. These reëntrants may be nearly opposite but are usually alternating, and extend so far across to the opposite side as to cut off triangular prisms. In most species the molars grow from persistent pulps, but in some they develop roots in the adult. Miller and Gidley point out that in the anterior two upper molars the posterior termination is never rounded but angular, and there is often or usually a distinct postorbital ridge or process on the squamosal. The group is typically a boreal one, found across the entire palæarctic area, particularly in temperate latitudes. The following key will serve to distinguish the genera of China and Mongolia, although it may be said that there is as yet a certain amount of disagreement among authors as to what limits may be assigned to genera and subgenera. For an excellent review of the characters of these major groups, see Miller's "Genera and Subgenera of Voles and Lemmings" (North Amer. Fauna, no. 12, 1896) and Hinton's "Monograph of the Voles and Lemmings" (British Museum, 1926). In the former the genus *Microtus* was used to include some eleven different subgroups then regarded as subgenera, but in the latter work further study results after thirty years in regarding all these as valid genera. Yet there are so many connecting links between the groups that they become difficult to define, and in some cases the differences between species referred to a single genus seem greater than the generic characters themselves. Although usage is still somewhat uncertain, I have followed Hinton (1926) in most cases, believing that the emphasis upon the subgroups may as well in this case find convenient expression by using them as genera where so many species are involved. No doubt further study will in future somewhat modify Hinton's conclusions, as he himself freely admits. Thus Osgood (1932) would make *Antelionomys* a subgenus of *Eothenomys*, although Hinton regards both as valid genera, and thirty years previously Miller included them both as subgenera of *Microtus*, a course which still has much to recommend it as expressing perhaps the close relationship of all these groups. The subgenus *Caryomys* of Thomas is curiously enough interpreted by Hinton as synonymous with *Evotomys* (= *Clethrionomys*), and all its described species as identical with *E. rufocanus*, but this is obviously a mistake, for not only are the bodily proportions different but the color as well, and the teeth, though patterned after much the same style in both, are nevertheless distinctly more angular in the structure of their prisms, while on the other hand the palate is as much like that of *Clethrionomys* as is that of *Eothenomys*, with which it may be regarded as bridging in some degree the gap between these genera. I have therefore resuscitated it as a subgenus of *Eothenomys*.

KEY TO GENERA AND SUBGENERA OF CHINESE AND MONGOLIAN MICROTINÆ

- I. Zygomata widely flaring; third upper molar consisting of four transverse prisms. *Myopus*
- II. Zygomata less spreading; third upper molar consisting of an anterior transverse prism followed by two or more alternating triangles.
- A. Palate ending as a thin transverse shelf without a median bony bridge sloping dorsally to join the mid-point of the edge of the mesopterygoid fossa.
- a. Dorsal coloration decidedly red; teeth rooted in adults. *Clethrionomys*
- b. Dorsal coloration not red; teeth not developing roots in the adult.
- a'. General color above dark brown. *Eothenomys*
- a''. Opposite triangles of first lower molar confluent.
1. Second upper and all lower molars with the triangles of opposite sides tending to form pairs with confluent bases; third upper molar less elongate. Subgenus *Eothenomys*
2. Second upper molar usually lacking a second inner triangle; third upper molar more elongate. Subgenus *Antelionomys*
- b''. Opposite triangles of first lower molar closed and separate. Subgenus *Caryomys*
- b'. General color above gray, tail white; teeth tending to have enamel prisms narrowed posteriorly. *Alticola*
- B. Palate not ending posteriorly as a transverse shelf, but its middle point continued as a narrow bony bridge, sloping dorsally to join the anterior edge of the mesopterygoid fossa, separating the two lateral pits.
- a. Upper incisors not grooved.
- a'. Tail usually longer than hind foot; last upper molar with two outer triangles, its terminal lobe curled inward. *Microtus*
- a''. External form not specially modified for burrowing, ears projecting above fur, tail more than 1½ times length of foot.
1. First lower molar with four or usually five closed triangles in front of the posterior transverse space.
- a. Skull not especially narrowed, or elongate in the interorbital region, zygomata bowed. Subgenus *Microtus*
- b. Skull narrow, interorbital region elongate, zygomata nearly parallel-sided. Subgenus *Stenocranius*
2. First lower molar with three closed triangles in front of the posterior transverse space, the fourth and fifth at the anterior end confluent. Subgenus *Neodon*

KEY TO GENERA AND SUBGENERA OF CHINESE AND MONGOLIAN MICROTINÆ (Cont'd)

- b''. External form modified for burrowing; ears reduced, feet with strong claws, tail less than $1\frac{1}{2}$ times length of hind foot. Second lower molar with two inner and two outer closed triangles. Subgenus *Phaiomys*
- b'. Tail very short, much less than the length of the hind foot; last upper molar ending in a short lobe in the axis of the tooth row.
 - a''. Second lower molar with four closed and alternating triangles in front of the posterior transverse space. *Lagurus*
 - b''. Second lower molar with its four triangles forming two opposite pairs, each pair with the bases confluent, making a lozenge-shaped transverse space. *Ellobius*
- b. Upper incisors grooved; terminal lobe of last upper molar bent outward. *Proedromys*

Genus *Myopus* Miller

RED-BACKED OR GRAY LEMMINGS

Myopus Miller, Smithsonian Misc. Coll., vol. 52, p. 497, 1910.

Myodes Liljeborg, Öfvers. Kongl. Vet.-Akad. Förhandlingar, Stockholm, vol. 1, p. 33, 1844 (in part).

Lemmus Trouessart, Faune Mamm. d'Europe, p. 199, 1910 (in part).

These red-backed, gray-sided lemmings are the most primitive of the Old World Lemmi, having the feet as in the Microti, with the terminal phalanx of the fore foot not enlarged but much shorter than either the first or the second, instead of equaling the combined length of both. Externally they resemble short-tailed Microti in bodily form, but the skull and teeth are much as in *Lemmus*, with which they were usually grouped until placed in a special genus by Miller. Nevertheless, the skull is distinguished by its relatively smaller size and lighter build, larger incisive foramina, slightly more globular bullæ and has the squamosals more widely separated in front. As in *Lemmus* the root of the lower incisor is relatively shorter than in *Microtus*, extending ventrally as far as the last molar only, instead of continuing beyond the tooth row in the mandible.

There seems to be but a single well-defined species in the more boreal part of the Eurasian continent, of which the other described forms are doubtless to be regarded as subspecies. One of these reaches the northern edge of the Mongolian area.

345. *Myopus schisticolor saianicus* Hinton

Myopus saianicus Hinton, Ann. Mag. Nat. Hist., ser. 8, vol. 13, p. 343, 1914; Monogr. of Voles and Lemmings, vol. 1, p. 182, text fig. 74 (skull), 1926.

Lemmus obensis Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 9, p. 401, 1912 (not of Brants, 1827).

Type specimen.—An adult male, skin and skull, No. 12.4.1.126, British Museum, from the Syansk Mountains, one hundred miles west of Lake Baikal, Siberia, altitude 2,200 feet. Collected by Douglas Carruthers, June 12, 1910.

Description.—Muzzle and sides of the head including the ears, the sides of the neck, the flanks, and the limbs, slaty gray, slightly mixed with black hairs, and hence darker than the lower surface of the body which is a clearer slaty gray. The entire mid-dorsal area of the body from the base of the tail to the shoulders, and extending forward as a narrower duller stripe on the nape, is ochraceous rufous to chestnut, with a few all-black hairs sprinkled evenly across the back. Backs of the feet dusky, the tail similar above, pale buffy below. In winter pelage the chestnut is probably partly obscured and the general color grayer.

The skull is well figured by Hinton (1926, fig. 74). As in *Lemmus* the zygomata are widely flaring anteriorly. The muzzle is short and slender, of the same width from base to tip; the interparietal is broad, with a short, pointed projection forward in the median line. The upper tooth rows are widely divergent behind, and the bony palate ends posteriorly in a short median point about on the same transverse level as the front of the last molar. The first upper molar has an anterior transverse prism and on the outer side two others, each extending nearly across the tooth, and alternating with two much smaller prisms on the inner side. The second upper molar consists of four prisms, of which the third is small and lies on the inner side of the tooth. The third upper molar consists of four enamel prisms, each of which is narrow and extends transversely quite across the tooth, the second and third joined by a narrow isthmus near the middle of the tooth, the others at their inner and outer edges respectively. In this tooth the interspaces between these transverse folds are filled in with cement. The interorbital region of the skull is narrow, and the masseteric ridges meet in the median line to form a sharp crest.

Measurements.—The following flesh measurements are recorded on the labels by the collector:

No.	Total length	Tail	Hind foot	Ear	Locality
46038	110	15	16	12	Mongolia
46116	110	—	16	14	Mongolia
46215	90	15	17	12	Mongolia
57486	114	14	17	11	Mongolia

CRANIAL MEASUREMENTS OF *MYOPUS*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars posteriorly	Upper cheek teeth	Lower cheek teeth	Locality
46038	26.0	24.2	14.5	16.8	13.0	6.7	7.4	7.0	Mongolia
46116	26.0	24.1	14.7	16.5	13.2	6.8	7.6	7.4	Mongolia
46215	24.5	22.5	13.7	14.6	12.5	6.8	7.0	6.5	Mongolia
57486	26.0	24.6	13.9	16.5	12.6	6.5	7.0	7.0	Mongolia

Occurrence and Habits:—There can be no doubt that this lemming is but a slightly marked subspecies of the animal first made known from Norway and Sweden as *M. schisticolor*, for the differential characters are minute and not very striking. Specimens of the group have been rather rare in collections. Middendorff reported it from the shores of the Okhotsk Sea some eighty years ago, but for a long time his record was believed to be erroneous. In 1912, however, Hollister secured a single specimen in the western Altai which he described as *M. morulus*, and two years later Hinton named the present animal on the basis of a single individual from the Syansk Mountains. The American Museum Asiatic Expeditions were fortunate in securing a splendid series of this lemming, fourteen specimens from localities fifteen and forty-five miles north-east of Urga in northern Mongolia, and four more at Sainnoin Khan to the westward. It is a forest-living species and its presence in these localities marks nearly the southward extent of the northern larch forest in southern Siberia. One specimen is said to have been trapped in "wet moss."

Specimens examined:—In all, eighteen, in addition to the type in the British Museum, namely:

Mongolia: fifteen miles northeast of Urga, 6; forty-five miles northeast of Urga, 8; Sainnoin Khan, 8,000 feet, 4.

Genus *Clethrionomys* Tilesius

RED-BACKED MICE

Clethrionomys Tilesius, Isis, Encyclopædische Zeits. verzug. f. Naturg., Physiol., etc., no. 2, p. 28, 1850. Palmer, Proc. Biol. Soc. Washington, vol. 41, p. 87, 1928.
Evotomys Coues, Proc. Acad. Nat. Sci. Philadelphia, 1874, p. 186.

This group has been so long known as *Evotomys* that it seems unfortunate that an older name should have been discovered recently in a rare and obscure publication brought to light by Dr. T. S. Palmer, who has, in calling attention to it, designated *Mus rutilus* Pallas of Siberia as the type. In external form the mice of this genus are much like *Microtus* although the ears are somewhat larger, while the color is usually reddish above. It is distinguished further by the form of the bony palate which terminates in a thin-edged shelf continuous from side to side between the last upper molars. In general the skull is more delicate, the mandible weak. The incisors are ungrooved, and the root of the lower incisor runs back in the bone of the jaw, crossing the line of the tooth row under the second and third molars, and ending in the ramus of the mandible at about the level of the last molar, below the dental foramen. The molars are rootless in the young, but with age develop two roots each. The enamel pattern resembles that of the microtines with four prisms in the second upper molar, but the salient angles are mostly rounded; the outer prisms are about

equal to the inner, the first lower molar has five closed or nearly closed triangles, and the last upper molar three.

Although but two species of the genus are yet known to occur in China and Mongolia, there can be little doubt that a third species will eventually be found, for Thomas in 1911 described *Evotomys glareolus saianicus* from the Syansk Mountains, one hundred miles west of Lake Baikal on the Mongolian border, thus extending the known range of this darker brownish vole almost to the northern limit of the area here covered.

KEY TO CHINESE AND MONGOLIAN SPECIES OF *Clethrionomys*

- A. Size smaller, skull length less than 25 mm.; tooth angles more rounded.
 - a. Last upper molar with anterior outer reëntrant usually shallower than the posterior, so that it does not cut off a small external closed triangle. *C. glareolus saianicus*
(extralimital)
 - b. Last upper molar with the anterior outer reëntrant at least as deep as the posterior, cutting off an outer triangle. *C. rutilus russatus*
- B. Size larger, skull length 25 mm. or more; tooth angles less rounded. *C. rufocanus*
 - a. Colors darker, less ochraceous. *C. rufocanus rufocanus*
 - b. Colors paler, sides ochraceous buff. *C. rufocanus shanseius*

346. *Clethrionomys rutilus russatus* (Radde)

Arvicola (*Hypudæus*) *russatus* Radde, Reisen im Süden von Ost-Sibirien, vol. 1, p. 186, pl. 7, figs. 2-2e, 1862.
Evotomys rutilus russatus G. M. Allen, Amer. Mus. Novitates, no. 133, p. 2, 1924. Hinton, Monogr. of Voles and Lemmings, vol. 1, p. 240, 1926.

Type specimen.—An immature specimen in alcohol, collected by Gustav Radde in the eastern Syansk Mountains on or near the border between Mongolia and Siberia. It is "perhaps in Leningrad" (Hinton).

Description.—Typical *rutilus* came from the mouth of the Obi, so that there is much doubt if the Syansk form is quite the same. A series from the western Altai differs in having the dorsal coloring not so bright while their tails are blackish instead of reddish like the back. The value of these differences can hardly be judged until topotypes of both in adequate series are compared, but for the present Radde's name may be retained in a subspecific sense. Forehead, crown, nape and central area of the back a bright chestnut, between ochraceous-rufous and chestnut, each hair with a slaty base and ochraceous-rufous tip, while the addition of scattered all-black hairs slightly darkens the whole. Muzzle, sides of the face to the eyes, and the flanks, buff, lined with scattered all-black hairs. Ears ochraceous rufous on their exposed portion, paler, whitish on the under side. Feet dusky due to a mixture of buffy and blackish hairs. Tail above, ochraceous rufous with scattered blackish hairs; below, pale, nearly clear buffy. Hairs of the under side of the body gray-based,

with whitish tips, often with a faint wash of buffy. Winter coat probably much paler and buffier.

The skull is delicate, with very slender zygomatic arches. In the upper molars the enamel triangles are clearly alternating, and rather angular, not with the rounded corners of *C. glareolus*. As pointed out by Miller, the second upper molar has four triangles, while the last upper molar is characterized by having always three deep reëntrant angles on its inner side, usually two on the outer side.

Measurements.—The following are field measurements of this subspecies.

No.	Head and body	Tail	Hind foot	Ear	Locality
46228	100	25	19	14	Mongolia
46245	95	27	18	19	Mongolia
46308	95	25	20	16	Mongolia
46317	95	25	18	15	Mongolia

CRANIAL MEASUREMENTS OF *CLETHRIONOMYS RUTILUS RUSSATUS*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
46334	23.7	20.7	11.4	12.5	11.3	4.8	4.6	4.6	Mongolia
46228	24.0	21.5	11.5	12.8	11.7	4.7	4.6	4.6	Mongolia
46245	23.8	22.0	10.4	13.0	11.6	4.6	4.5	—	Mongolia
46265	22.8	20.4	10.8	11.8	10.9	4.7	4.7	4.7	Mongolia
46274	22.7	20.3	11.0	12.0	11.0	4.8	4.6	4.7	Mongolia
46308	23.2	20.3	10.5	11.8	11.5	4.7	4.7	4.5	Mongolia
46363	22.6	20.5	11.5	12.2	11.5	4.9	4.7	4.7	Mongolia
46317	23.7	20.9	11.4	—	11.5	4.7	4.8	4.7	Mongolia

Occurrence and Habits.—The mice of this genus, being rather strictly forest-living, are not found southward of the larch and birch woods of northern Mongolia, but follow the forest borders along the northern edge of the Gobi. Dr. Andrews found this a common species in suitable localities at fifteen and forty-five miles northeast of Urga but not elsewhere. It is quite possible, when a study of the species is made with larger and more representative series from elsewhere in northern Asia, that this subspecies will prove hardly separable. Winter specimens are much paler than those in summer pelage.

Specimens examined.—In all, one hundred and twelve, as follows:

Mongolia: fifteen miles northeast of Urga, 68; forty-five miles northeast of Urga, 44.

347. *Clethrionomys rufocanus rufocanus* (Sundevall)

Hypudæus rufocanus Sundevall, Öfvers. Kongl. Vet.-Akad. Förhandlingar, Stockholm, vol. 3, p. 122, 1846.

Evotomys (Craseomys) rufocanus latastei Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 9, p. 397, 1912. Syansk Mountains, west of Lake Baikal.

Evotomys rufocanus G. M. Allen, Amer. Mus. Novitates, no. 133, p. 2, 1924.

Evotomys rufocanus rufocanus Hinton, Monogr. of Voles and Lemmings, vol. 1, p. 248, 1926.

Type specimen.—According to Hinton, the type is in the Stockholm Museum. It came from Lappmark, northern Sweden.

Description.—The dull-red back, slaty muzzle, and grayish-buff flanks will usually suffice to distinguish this species externally from the preceding. Forehead, nape and dorsal area, a dark but bright chestnut, the muzzle and sides of the head and the flanks distinctly and contrastingly gray, sometimes with a slight admixture of buffy where the gray of the sides passes into the reddish of the back. Tail bicolor, black with slight admixture of paler hairs above, grayish white below. Below, the entire throat and belly are pale gray, the bases of the hairs darker. Backs of the feet dusky to pale gray. In winter skins the reddish of the back is paler.

The skull is rather heavier than that of other Asiatic species of the genus, the teeth proportionally large. Compared with the molars of *C. rutilus russatus*, the pattern is much the same but with a tendency to having the enamel prisms with rounded outlines; the last upper molar has two deep re-entrant angles on the inner side, and the first lower molar has five closed spaces in addition to the anterior loop, instead of having the opposite triangles confluent at their bases.

Measurements.—Collector's field measurements of a series from Mongolia are as follows:

No.	Head and body	Tail	Hind foot	Ear	Locality
46223	105	27	19	15	Mongolia
46224	122	30	17	16	Mongolia
46238	115	30	20	19	Mongolia
57492	100	35	18	18	Mongolia
57499	103	34	20	15	Mongolia

CRANIAL MEASUREMENTS OF *CLETHRIONOMYS RUFOCANUS*

No.	Greatest length	Basal length	Palatal length	Zygomastic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
<i>C. rufocanus rufocanus</i>									
46223	24.6	22.6	12.4	13.7	12.1	5.0	5.9	5.5	Mongolia
46224	26.5	24.5	13.8	14.5	13.0	5.2	5.8	5.8	Mongolia
46239	26.4	23.9	13.7	—	13.2	5.2	5.8	5.7	Mongolia
46293	25.5	23.5	12.9	13.8	12.2	5.0	6.2	6.0	Mongolia
46331	25.3	23.7	13.5	14.6	11.7	5.5	6.0	6.0	Mongolia
46373	25.0	22.7	12.3	13.7	12.4	4.9	5.8	5.5	Mongolia
57492	26.1	23.8	13.0	14.0	13.0	5.0	6.4	6.1	Mongolia
57499	27.5	25.3	13.7	14.7	12.9	5.3	6.5	5.8	Mongolia
<i>C. rufocanus shanseius</i>									
45441	25.3	23.3	13.0	14.8	12.8	5.3	6.4	6.0	Shansi
45442	25.8	24.0	13.8	14.7	12.5	5.1	6.5	6.2	Shansi
45443	25.4	23.1	13.0	13.8	12.0	5.0	6.3	6.2	Shansi

Occurrence and Habits.—This species occurs in the same localities with *C. rutilus* across northern Eurasia, but can usually be distinguished externally by its very gray muzzle and sides. The form is slightly heavier, the skull and teeth decidedly larger, while the last upper molar is simpler, ending in a somewhat Y-shaped lobe, ahead of which are two small closed spaces and a transverse lobe, so that on the inner side of the tooth there are two deep reëntnants instead of three. A comparison of the series obtained by the American Museum Asiatic Expeditions in northern Mongolia with specimens from Scandinavia representing the typical form reveals no differences of significance. Two specimens from Korea are a very little richer in coloring, tending to more ochraceous on the sides instead of dark gray, and represent the race *regulus*. The species is forest-living and extends across northern Mongolia as far south as the forest encroaches upon the Gobi. Dr. Andrews and his associates secured a series at Sainnoin Khan, Mongolia, and found it common also at the localities fifteen miles north and forty-five miles northeast of Urga, where *C. rutilus russatus* was taken. At the former locality in the first half of June, specimens still retained a little trace of the whiter winter fur on the belly, and at the latter locality young were taken in the first week of August. Young about three weeks old were taken in early June at Sainnoin Khan. Probably the range continues eastward along the extreme northern edge of Mongolia to the more forested country of western Manchuria, and somewhere in this region or east of it intergradation takes place with the race *C. r. regulus* of Korea. Indeed Thomas has identified a specimen from the Eastern Tombs, Hopei, as of that form, but probably it is better regarded as *C. r. shanseius*.

Hinton (1926) concluded that the long-tailed brownish voles described as members of the subgenus *Caryomys* by Thomas were in reality the immatures of this species, but A. B. Howell is unquestionably right in his contention that they represent a distinct species, probably to be referred to *Eothenomys*.

Specimens examined.—In all, sixty-seven, as follows:

Mongolia: Sainnoin Khan, 14; fifteen miles north of Urga, 18; forty-five miles northeast of Urga, 35.

348. *Clethrionomys rufocanus shanseius* (Thomas)

Craseomys shanseius Thomas, Proc. Zool. Soc. London, 1908, p. 643.

Eutamias rufocanus shanseius G. M. Allen, Amer. Mus. Novitates, no. 133, p. 3, 1924.

Clethrionomys rufocanus shanseius Howell, Proc. U. S. Nat. Mus., vol. 75, art. 1, p. 51, 1929.

Type specimen.—An adult male, skin and skull, No. 8.8.7.85, British Museum, from one hundred miles northwest of Taiyuanfu, Shansi, China. Collected December 4, 1907, by M. P. Anderson.

Description.—Similar to typical *Clethrionomys rufocanus*, but the reddish area of the back is less rufous and the sides more ochraceous, so that the general

appearance is paler, and more yellowish brown. General color of the mid-dorsal area from muzzle to base of tail, light cinnamon rufous, evenly lined with black; the sides of the face to the eyes and ears and the flanks, pale ochraceous. Hairs of the ventral surface of the body slaty at base with whitish tips, very lightly washed with pale buffy. Tail short, its upper side dark brown, more or less mixed with gray or buffy; its under side whitish, sharply separated. Backs of the feet whitish.

Skull not different from that of typical *C. rufocanus*.

Measurements.—The following measurements are from fresh-killed specimens, as taken by the collector:

No.	Head and body	Tail	Hind foot	Ear	Locality
45442	106	30	20	14	Shansi
45441	105	25	20	15	Shansi
45443	106	27	21	13	Shansi

For cranial measurements, see table under *C. r. rufocanus*.

Occurrence and Habits.—Although this race is described as paler than the typical form, it is not yet altogether clear how far this condition may be seasonal, since most of the specimens hitherto obtained seem to have been taken in the late autumn or in winter. At all events, the series so far examined seems to be noticeably paler than northern and western specimens available for comparison. The range of this race is separated from that of the typical *C. rufocanus* on the north by the east-west prolongation of the Gobi, but doubtless to the east of Mongolia in northeastern China and Manchuria, the two come together, and intergrade with the Korean race *C. r. regulus*. A series from Hopei, one hundred miles northeast of Peiping, seems indistinguishable from Shansi specimens in the winter coat, and Thomas (1908f, p. 643) has regarded a single specimen from the Eastern Tombs as individually indistinguishable from *C. r. regulus*, so that evidently the three races are very similar.

The original series came from a locality one hundred miles northwest of Taiyuanfu, Shansi, and Thomas later recorded others from near the same region taken in brush-grown gullies and canyons a short distance northwest of Kolanchow. Sowerby (Clark and Sowerby, 1912, p. 182), who with M. P. Anderson secured the type series, writes that all were trapped among moss-grown rocks in or near dense spruce or larch woods, one on the summit of Moer Shan, the highest peak in the district. It was common in these mountainous well-wooded districts but not elsewhere. Dr. Andrews secured his series at Kweihwacheng, Shansi, and at a locality one hundred miles northeast of Peiping. An old female of the Kolanchow series had five embryos on June 2.

Specimens examined:—In all, thirty-one, as follows:

Hopei: one hundred miles northeast of Peiping, 5.

Shansi: Kweihwacheng, 10; one hundred miles northwest of Taiyuanfu, 10 (B.M.); twelve miles north of Kolanchow, 6 (B.M.).

Genus *Eothenomys* Miller

Eothenomys Miller, North Amer. Fauna, no. 12, p. 45, 1896 (as a subgenus of *Microtus*). Hinton, Ann. Mag. Nat. Hist., ser. 9, vol. 11, p. 145, 1923 (as a genus).

Arvicola Milne-Edwards, in David, Nouv. Arch. Mus. d'Hist. Nat. Paris, vol. 7, Bull., p. 93, footnote, 1871 (not of Lacépède, 1799).

Microtus Blanford, Fauna British India, Mammalia, p. 434, 1891 (in part).

This genus is in many ways annectant between the more typical *Microtus*-like groups and the red-backed mice, *Clethrionomys*. In the conformation of the palate it resembles the latter, with the bony palate ending posteriorly as a transverse shelf extending across between the anterior ends of the last molars, its median point ending in a slight projection or none. There is no sloping bony bridge extending from the median point of the palatal edge dorsally to join the forward end of the mesopterygoid fossa. The teeth are rather weak, without, however, the very rounded angles of the red-backed group. The molars are rootless, the alveolar capsule of m^2 protruding in the orbital fissure. The enamel pattern of the upper molars usually shows the first with a well-developed fourth inner or postero-internal angle, and the second molar usually with a similar (third) angle, confluent with the angular prism of the outer side. In the lower molars the pattern is less variable, the first lower molar having the bases of the triangles more or less confluent, instead of forming closed triangles of enamel, and there are four outer and five inner salient angles. In the two posterior lower molars there are three outer and three inner salient angles, and the triangles are confluent at the bases, making transverse lozenge-shaped prisms.

In color the members of this group are dark, with scattered burnished pale tips among the fur giving a characteristic appearance. The mammae are reduced to but two inguinal pairs, correlated with small litters.

Hinton, the latest author to review the group as a whole, raised *Eothenomys* to generic rank in 1923, recognizing four well-marked species, all of which are confined to the Chinese highlands eastward to Fukien and west to the near-by borders of Burma. It is therefore of especial interest as representing an annectant line, "which seems to be an offshoot from some primitive *Evotomys*-like stock," still surviving in southeastern Asia, an area that seems to be an asylum for various relicts of the Microtinæ. The type species is *Arvicola melanogaster* Milne-Edwards from central Szechwan, of which a number of subspecies have been named, although it seems unlikely that all are entitled to even sub-specific standing. The Chinese forms may be recognized by the following key based on that published by Hinton (1926, p. 284).

KEY TO THE CHINESE SPECIES OF *Eothenomys*

- A. Opposite triangles of first lower molar usually confluent transversely.
- a. First upper molar with three outer and four inner salient angles; last upper molar with three or four outer salient angles. Subgenus *Eothenomys*
- a'. Second upper molar symmetrical, with the postero-internal angle well developed. *E. melanogaster*
- a''. Smaller, skull less than 26.5 mm. long.
1. Last upper molar with three inner and three outer salient angles.
- a. Color slightly darker (western highlands) *E. melanogaster melanogaster*
- b. Color slightly paler (eastern lowlands) . . . *E. m. columnus*
2. Last upper molar with four inner and three outer salient angles; tail long, about 45 mm.
- a. Color above more grayish brown. *E. elcuscis*
- b. Color above brighter, near hazel. *E. miletus aurora*
- b''. Larger, skull length 26.5 mm. or more. *E. miletus*
- b. First upper molar with three outer and three inner salient angles.
- a'. Last upper molar with four outer salients, and the first outer reëntrant too shallow to separate the first outer triangle from the anterior transverse space. Subgenus *Anteliomys*
- a''. Size small, skull flattened, its length about 21 mm. *E. olitor*
- b''. Size larger, skull normal, its length about 26 mm. *E. proditor*
- b'. Last upper molar with four or five outer salients, second upper molar lacking a pronounced postero-internal angle.
- a''. Larger, tail more than 60 mm., foot more than 20 mm. *E. chinensis* and races
- b''. Smaller, tail less than 60 mm., foot less than 20 mm. *E. custos*
1. Tail to about 44 mm.
- a. With a buffy wash below. *E. custos custos*
- b. Without a buffy wash below, browner. . . *E. c. rubellus*
2. Tail about 50 mm. *E. c. hintoni*
- B. Opposite triangles of first lower molar alternating and separate. Subgenus *Caryomys*
- a. Tail long, about 55-60 mm. *E. eva*
- b. Tail short, about 40 mm. *E. inez*

Subgenus ***Eothenomys*** Miller

Eothenomys Miller, North Amer. Fauna, no. 12, p. 45, fig. 22, 1896.

It is rather characteristic of the typical subgenus *Eothenomys* to have a third inner salient angle on the second upper molar as well as on the first, and this triangle

is broadly confluent at its base with the last outer one in both teeth which are therefore nearly bilaterally symmetrical. The third upper molar typically has the anterior outer reëntrant deep enough to cut off the transverse space in front, and an outer triangle which is confluent at its base with the anterior inner triangle. The tooth is less elongated than in *Antelionomys*, with usually three outer and three or four inner salients, depending on whether the posterior heel is a lengthwise lobe, or has an inner recurved portion. In the lower jaw the pairs of inner and outer triangles tend to be more or less opposite and confluent at their inner bases in all three molars, the second tooth especially being nearly symmetrical bilaterally. Some of the variations shown by *E. proditor* and *E. olitor*, however, are decidedly annectant in the direction of *Antelionomys*, so that, as Osgood has shown, it is hardly possible to keep the two groups apart as distinct genera.

349. *Eothenomys melanogaster melanogaster* (Milne-Edwards)

Arvicola melanogaster Milne-Edwards, in David, Nouv. Arch. Mus. d'Hist. Nat. Paris, vol. 7, Bull., p. 93, footnote, 1871; Recherches pour servir à l'Hist. Nat. des Mammifères, p. 284, pl. 44; pl. 46a, figs. 1-1d, 1868-74 (1871).

Microtus melanogaster Blanford, Fauna British India, Mammalia, p. 434, 1891.

Microtus (Eothenomys) melanogaster Miller, North Amer. Fauna, no. 12, p. 46, 1896.

Microtus (Eothenomys) mucronatus G. M. Allen, Mem. Mus. Comp. Zool., vol. 40, p. 214, 1912. Tachiao, western Szechwan.

Eothenomys melanogaster melanogaster Hinton, Ann. Mag. Nat. Hist., ser. 9, vol. 11, p. 149, 1923.

Eothenomys melanogaster mucronatus Hinton, Monogr. of Voles and Lemmings, vol. 1, p. 289, 1926.

Type specimens.—None mentioned; the species was based on specimens sent by Père Armand David to the Paris Museum from Muping, western Szechwan, China.

Description.—Entire upper surface of the head and body a uniform "Prout's brown," due to a mixture of hairs having dark slaty bases and shining ochraceous tips with evenly scattered all-black hairs. The burnished tips of ochraceous catch the light and give back bronzy reflections that are very characteristic of the mice of this genus. Muzzle and backs of the feet dark brown. Tail dark brown above, paler below, and so thinly haired that the scaling shows through on minute inspection. Entire under surface of the body from chin to root of tail, dark slaty, sometimes with a faint wash of ochraceous across the chest. The tips of the hairs over this area are to a varying degree provided with polished tips that shimmer in certain lights with a characteristic effect.

Immature animals are much darker, with less of the ochraceous tipping to the hairs, as fairly well illustrated in Milne-Edwards's colored plate in which, as he points out, the lower figure represents a browner condition, while

the upper figure is much more slate-colored, due either to immaturity or to a moulting condition. Melanos are occasional; the British Museum has one from southwest of Yachow, Szechwan, and a young one from Wenhsien, Kansu.

The skull in profile is rather flattened, but with a slight and very even convexity to the upper outline. The nasals are exceeded in backward extent by the premaxillaries which extend slightly less than a millimeter posterior to them. The interorbital space is broad and nearly flat without prominent crests meeting in the midline. The postorbital ridges overhang but little and are only feebly developed. The palate ends in a shelf of bone extending across between the front ends of the last molars, with a median point of bone which may be very little developed in younger animals. The lateral pits extend forward under this shelf and lack the median bony bridge sloping up and back between them. The first upper molar has four inner and three outer angles, and consists of a transverse prism, then three triangular prisms (two inner and one outer), of which the second and third are usually confluent by a very narrow isthmus; finally there follow an inner and an outer prism widely confluent at their inner bases. The second upper molar has three inner and three outer salient angles, and consists of a transverse prism of enamel followed by two inner and two outer triangles, each pair of which is so nearly opposite and widely confluent at the bases that the tooth is nearly bilaterally symmetrical. The last upper molar is like the second in having three inner and three outer angles, and in being nearly bilaterally symmetrical, so that the inner and outer prisms come opposite each other and are widely confluent at their bases, but the posterior end of the tooth is produced into an elongate heel. The first lower molar has four outer and five inner salient angles, and consists of an anterior trefoil, followed by three closed spaces that extend quite across the tooth, the first two being due to the confluence in the middle line of the intervening two pairs of opposite triangles. The second and third teeth are essentially alike and consist each of three transverse prisms, almost identical in structure with the last three spaces of the first molar.

A specimen (No. 11.9.8.120) in the British Museum from Chinfu Shan, Szechwan, is interesting as having the terminal lobe of the last upper molar turned in to make a small fourth inner salient on the right side, while on the left side the terminal heel is straight and directed posteriorly, making but three salients on inner and outer borders, as usual.

Measurements:—The typical subspecies is small and dark with a short tail. The following external measurements were taken by M. P. Anderson from fresh specimens, and are copied from the labels of the series in the British Museum:

No.	Head and body	Tail	Hind foot (s. u.)	Ear	Locality
11.2.1.227 BM	96	—	16.0	10.0	Kansu
11.2.1.228 BM	92	40	16.0	10.0	Kansu
11.2.1.229 BM	87	34	16.0	10.0	Kansu
11.2.1.230 BM	96	43	17.0	10.0	Kansu
11.2.1.232 BM	95	34	16.0	10.0	Kansu
11.2.1.233 BM	96	36	17.0	10.0	Kansu
11.2.1.234 BM	93	36	16.0	10.0	Kansu
11.2.1.270 BM	90	33	15.5	10.0	Szechwan
11.9.8.120 BM	90	40	15.0	11.0	Szechwan
11.2.1.271 BM	89	42	16.0	9.5	Szechwan

CRANIAL MEASUREMENTS OF *EOTHENOMYS MELANOGASTER*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
<i>E. melanogaster melanogaster</i>									
7789 MCZ	25.7	23.8	13.7	15.4	12.3	5.5	6.5	6.4	Szechwan
7791 MCZ	26.4	24.2	14.1	15.5	12.3	5.7	6.6	6.0	Szechwan
7800 MCZ	22.8	21.0	12.0	13.4	11.3	4.7	5.5	5.4	Szechwan
7801 MCZ	22.9	20.5	12.2	13.3	11.0	5.1	4.7	5.6	Szechwan
7803 MCZ	24.8	22.4	12.7	14.0	11.6	5.3	6.0	6.1	Szechwan
7804 MCZ	23.9	21.7	12.3	14.0	12.2	5.0	6.2	5.7	Szechwan
11.2.1.227 BM	25.2	23.1	13.1	15.1	12.4	5.2	6.0	5.9	Kansu
11.2.1.228 BM	24.6	22.6	13.0	14.3	12.2	5.1	5.9	6.0	Kansu
11.2.1.229 BM	23.2	21.7	12.5	13.7	12.4	4.9	5.9	5.8	Kansu
11.2.1.233 BM	24.9	23.0	13.2	14.8	12.0	5.1	6.0	5.7	Kansu
<i>E. melanogaster colurnus</i>									
24303 MCZ	24.5	22.3	12.6	14.0	11.5	5.2	5.7	5.7	Chekiang
24304 MCZ	—	—	12.1	13.7	—	5.3	6.1	5.8	Chekiang
24305 MCZ	24.7	22.8	12.8	14.7	12.5	5.5	6.4	6.7	Chekiang
60328	24.5	22.3	12.9	14.5	11.7	5.1	6.1	6.2	Fukien
84776	25.3	24.6	13.1	14.6	11.5	5.5	6.0	6.2	Fukien
0.5.8.38 BM	25.9	24.0	13.0	—	12.0	5.5	6.8	6.8	Fukien
8.7.25.41 BM	25.3	23.3	13.2	15.2	11.8	5.2	6.4	6.5	Fukien
0.5.8.37 BM	25.7	23.8	13.8	15.0	12.0	5.3	6.0	6.5	Fukien
98.11.1.27 BM	25.5	23.8	13.1	14.8	12.5	5.4	6.5	6.0	Fukien

Occurrence and Habits:—This dark-bellied mouse was first made known by Milne-Edwards as one of the many discoveries of Père David in his exploration of the virgin territory of Szechwan in the early seventies. As pointed out by its describer, the last upper molar is almost bilaterally symmetrical, with three outer and three inner reëntrant angles in the typical form. There is a certain amount of color variation, the immature especially being darker on account of the many blackish bases of the hairs that show through the general pelage. Adults are much brighter in color, and all the members of the group

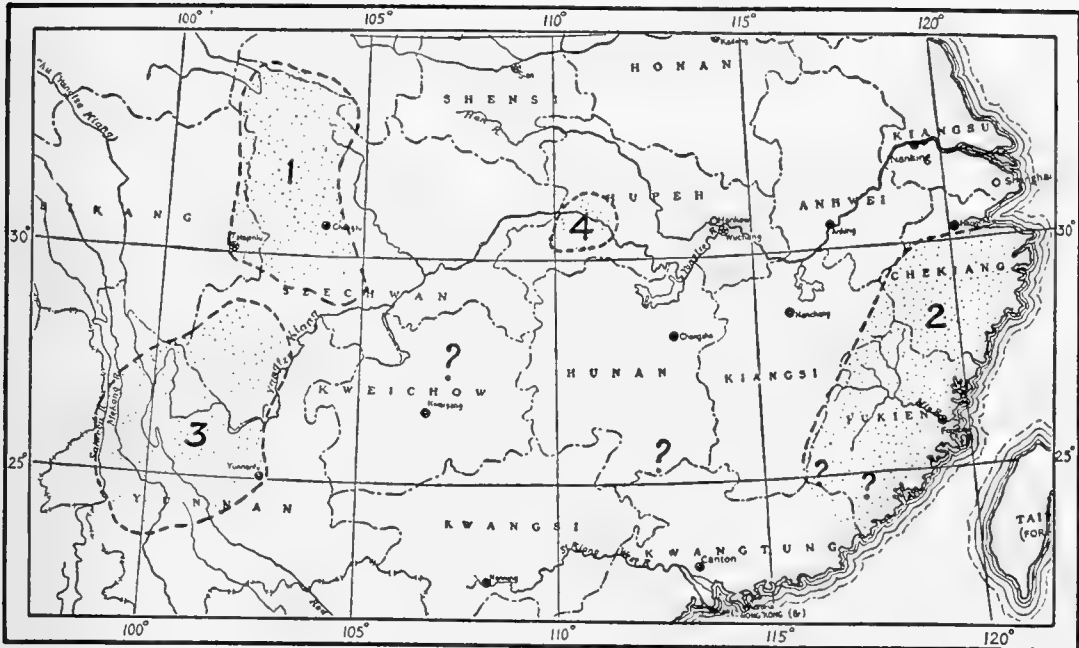


FIG. 32. Distribution Map.

Eothenomys

- | | |
|--|------------------------------|
| 1. <i>E. melanogaster melanogaster</i> | 3. <i>E. miletus miletus</i> |
| 2. <i>E. melanogaster colurnus</i> | 4. <i>E. miletus aurora</i> |

have rather characteristic brassy reflections due to the many burnished ochraceous tips to the hairs. There seems to be no question but that the animal I described (G. M. Allen, 1912) as *Microtus (Eothenomys) mucronatus* is after all identical with typical *E. m. melanogaster* and the name therefore becomes a synonym of the latter.

As Hinton (1926, p. 284) has clearly shown in his key to the named forms, they fall readily into two groups, one with the last upper molar showing three inner and three outer salient angles, the other having the last molar asymmetrical, with three outer and *four* inner angles, the fourth being due to the curling in and forward of the general heel of the tooth. To the former type belong all the specimens of typical *E. m. melanogaster* that I have seen from the Szechwan highlands, as well as those from the coastal provinces of Chekiang and Fukien referred to the subspecies *E. m. colurnus*. A series from Hupeh interposed between these areas is typical of the second group, which includes the more southern *E. miletus* and *E. eleusis*. While it is very likely that some of the subspecies described are hardly entitled to recognition, there seems to be no other course open at present but to list them provisionally, awaiting additional collections.

Typical *E. m. melanogaster* is now known from central Szechwan (type

locality Muping), with additional localities, as Omei Shan and forty-five miles southwest of Yachow (Thomas, 1911d, p. 176), Wa Shan and Tachiao (G. M. Allen, 1912, p. 211; Jacobi, 1922, p. 15). Thomas (1911d) has further recorded it from southern Kansu in the Wenhsien country, which is the northernmost record of the genus. In habits these mice are forest-living. Jacobi (1922) records that the Wa Shan specimens were trapped in pine and rhododendron forest at 3,400 meters by natives who had stolen the traps from Zappey when he collected there in 1907!

The westward range of the typical race is undetermined, but there is a specimen in the British Museum from the Mishmi Hills that seems to be quite the same.

Specimens examined:—In all, twenty-one, as follows:

Szechwan: Tachiao, 4; Wa Shan, 6 (M.C.Z.); Omei Shan, 1 (B.M.); Chinfu Shan, 1 (B.M.); southwest of Yachow, 1 (B.M.).

Kansu: Wenhsien, 8 (B.M.).

350. *Eothenomys melanogaster colurnus* (Thomas)

Microtus (Eothenomys) melanogaster colurnus Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 7, p. 209, 1911.

Microtus melanogaster Thomas, Proc. Zool. Soc. London, 1898, p. 775.

Microtus (Eothenomys) bonzo Cabrera, Bol. Real Soc. Esp. Hist. Nat., Madrid, vol. 22, p. 168, fig. 1, 1922.
Foochow, Fukien.

Eothenomys melanogaster colurnus Hinton, Ann. Mag. Nat. Hist., ser. 9, vol. 11, p. 149, 1923.

Type specimen:—An adult male, skin and skull, No. 0.5.8.38, British Museum, from Kuatun, northwestern Fukien, China. Collected October 24, 1899, by C. B. Rickett.

Description:—This is a barely distinguishable race, averaging less dark than typical *E. melanogaster*, the back and sides with the bright ochraceous tips of the hairs less marked, rather more drabby in general appearance, but otherwise quite similar, being "richer than 'hazel' instead of between 'bistre' and 'mummy brown'" (Thomas).

The skull is not distinguishable from that of the typical race, which it resembles in having the last upper molar provided with three outer and three inner salient angles.

Measurements:—The following are collector's measurements from fresh specimens:

No.	Total length	Tail	Hind foot	Ear	Locality
60328	146	42	17	11	Fukien
24303 MCZ	134	32	16	10	Chekiang
24304 MCZ	133	34	16	11	Chekiang
24305 MCZ	144	36	17	12	Chekiang

Thomas believed that the tail averaged slightly shorter than in the Szechwan race, typical *E. m. melanogaster*, but these measurements do not seem to bear this out.

For cranial measurements, see the table under the latter.

Occurrence and Habits.—This is presumably a coastal race confined to the wooded areas in Fukien and Chekiang. The animal was found commonly by Rickett, Styan, and La Touche, at Kuatun, Fukien, the type locality, whence a number were obtained. Mr. Clifford H. Pope secured five in the same neighborhood at Chungan, and Cabrera recorded it from Foochow, also in Fukien, under the name *Microtus (Eothenomys) bonzo*, but his description and figure of the teeth leave no doubt that he had the same animal in hand. There appear to be no other records for this vole in eastern China, so that it is interesting to record the capture of a small series of four at Tunglu, Chekiang, by J. T. Wright, of whom they were acquired by the Museum of Comparative Zoölogy, an extension of the known range northward to the mouth of the Yangtze.

There may be a slight seasonal difference in coloration, for the series from Kuatun in the British Museum seems to be all slightly more reddish in color than the other forms in that collection, and perhaps represents the summer pelage, for the winter specimens from Chekiang above noted are nearly as dark as typical *E. m. melanogaster* from Szechwan. This difference had apparently been noticed long ago by Milne-Edwards, for among the specimens in the British Museum were two of Père David's collecting from Kuatun, made up so as to lie on one side. The label of one of these has written on it, "*rubiginosus* n. sp.," a name that seems never to have been published.

Specimens examined.—In all, twenty, as follows:

Chekiang: Tunglu, 4 (M.C.Z.).

Fukien: Chunganhsien, 5; Kuatun, 11, including the type (B.M.).

351. *Eothenomys miletus miletus* (Thomas)

Microtus (Eothenomys) melanogaster miletus Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 14, p. 474, 1914.

Eothenomys melanogaster miletus Hinton, Ann. Mag. Nat. Hist., ser. 9, vol. 11, p. 149, 1923.

Eothenomys fidelis Hinton, *ibid.*, p. 150; Monogr. of Voles and Lemmings, vol. 1, p. 290, 1926. Likiang, Yunnan.

Microtus (Eothenomys) fidelis G. M. Allen, Amer. Mus. Novitates, no. 133, p. 4, 1924.

Eothenomys melanogaster fidelis Osgood, Publ. Field Mus. Nat. Hist., zool. ser., vol. 18, p. 323, 1932.

Type specimen.—A skin and skull, adult male, No. 14.10.23.32, British Museum, from ten miles west of Yangpi, western Yunnan, altitude 7,000 feet. Collected February 28, 1914, by F. Kingdon Ward.

Description.—A large species, rich dark reddish brown above and "blue gray" below, hind foot about 19 mm.; skull large and heavy. Externally this

is a bright-colored animal, with, however, two rather noticeable styles of pelage, one in which it is similar to the neighboring *E. eleusis*, the other much more russet. The former is nearly a Vandyke brown above with a plentiful mixture of black hair and only slightly paler on the sides; the latter is about "burnt umber," with much less black among the ochraceous-tipped hairs. The under surfaces are dark gray, with more or less whitish tipping to the hairs and often a faint overwash of buffy. The hairs of the under surface as well as those of the upper exhibit the frequent polished tips that shine in varying lights. The upper surface of the feet and of the tail is dusky, the latter paler on its ventral side due to the intermixture of many minute whitish hairs. The tail is so thinly haired that the rings of scales are readily made out.

The skull, in comparison with that of *E. melanogaster*, is much more heavily formed, with a broad interorbital space, stout zygomata, and a tendency to the development of prominent lambdoid ridges, as well as faint ridges across the parietals, in this respect, however, not so very different from typical *E. m. melanogaster*. The last upper molar has four inner salient angles and three outer. Otherwise the molar pattern is much as in the *E. melanogaster* group. The first upper molar has a transverse space, then three closed triangles (one

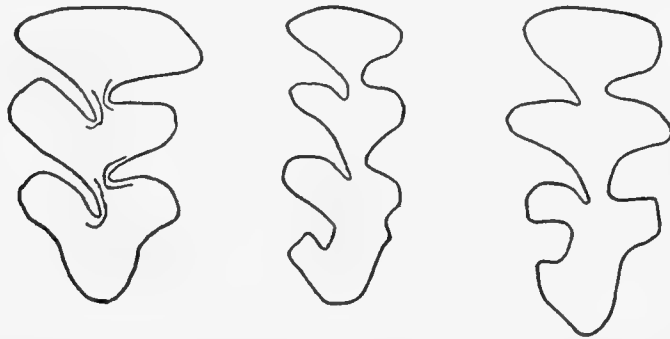


FIG. 33. Approximate outlines of the last upper molar in (left) *Eothenomys melanogaster colurnus*, type, No. 0.5.8.38, British Museum; (center) *E. miletus miletus*, type, No. 4.10.23.32, British Museum; and (right) *E. eleusis*, type, No. 11.9.8.111, British Museum. Much enlarged.

outer and two inner), followed by two triangles, an outer and an inner, with bases opening together. The second molar has three inner and three outer salients and consists of a transverse space followed by two pairs of triangles with the bases of each pair confluent, the second pair nearly equal. The third molar has a transverse space followed by two opposite triangles with their bases widely confluent, then a trefoil with a long median heel, and the inner petal the smallest. In the first lower molar there is a posterior transverse enamel prism, in front of which are two pairs of opposite triangles with their bases widely confluent, then an anterior portion consisting of a trefoil with two inner projections and one outer.

Measurements.—The large size of this species is one of its most striking characteristics. The following measurements were taken by the collectors in the field:

No.	Head and body	Tail	Hind foot	Ear	Locality
44027	115	47	20.5	—	Yunnan
44073	110	50	21.5	—	Yunnan
44076	120	45	21.0	—	Yunnan
44110	120	40	21.0	—	Yunnan
85005	119	46	19.0	14	Yunnan
85008	118	47	19.0	15	Yunnan
85009	116	41	19.0	12	Yunnan
14.10.23.32 BM (type)	114	48	19.0	13	Szechwan
22.12.1.8 BM (type of <i>E. fidelis</i>)	126	49	18.0	12	Yunnan

CRANIAL MEASUREMENTS OF *EOTHENOMYS MILETUS*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
<i>E. miletus miletus</i>									
44027	27.0	25.1	14.4	14.6	12.7	5.7	6.6	6.5	Yunnan
44073	28.2	26.6	15.1	15.8	13.4	5.6	6.8	6.5	Yunnan
44076	28.5	26.6	15.6	15.8	13.6	5.7	7.0	6.6	Yunnan
44010	26.5	24.7	13.5	14.5	12.1	5.6	6.5	6.5	Yunnan
85008	28.2	25.5	14.4	—	12.9	5.6	6.4	6.0	Yunnan
44109	25.2	23.6	13.7	15.3	12.0	5.5	6.2	6.2	Yunnan
14.10.23.32 BM	25.7	23.4	13.4	15.5	12.0	5.7	6.4	6.4	Yunnan
<i>E. miletus aurora</i>									
7185 MCZ	24.2	22.6	12.5	15.0	12.5	5.3	6.4	6.6	Hupeh
7188 MCZ	24.9	22.9	13.3	14.8	12.3	5.2	6.0	6.6	Hupeh
7788 MCZ	25.5	23.4	12.8	14.3	12.0	5.0	6.1	5.8	Hupeh
13.9.13.8 BM	—	—	13.5	14.8	—	5.0	6.0	5.8	Hupeh

Nomenclature.—This large species was first made known in 1914 from a single specimen taken at Yangpi, western Yunnan, by F. Kingdon Ward, and has since been regarded as of problematical status. I have lately been privileged to see the type in the British Museum, and find that, although it is a roughly made skin, it is nevertheless unquestionably the same as the animal described nine years later by Hinton as *E. fidelis*, on the basis of excellent skins from Likiang, northwestern Yunnan. The skulls of the two are substantially the same, heavily built, with broad, flat interorbital region, and a wide, strap-shaped interparietal, the anterior border of which is bowed forward in a point at the middle. The form of the last upper molar at once distinguishes it from the *E. melanogaster* type, with a well-defined posterior hook on the inner side, making four inner salient angles instead of three. The depth of the skull

through the audital bulla is also strikingly greater. Notwithstanding Dr. Osgood's suggestion that the animal should be regarded perhaps as a large race of the latter species, it seems now evident that it is really a distinct species of larger size.

Occurrence and Habits.—The range of this species is essentially more southern than that of the *E. melanogaster* group, yet it is found even at considerable altitudes in the highlands of western Yunnan. From the Likiang Range, whence came the type of *E. fidelis*, the American Museum Asiatic Expeditions secured a small series at altitudes of from 8,000 to 9,000 feet, but it evidently goes to the upper limit of tree growth, for the original specimen described as *E. fidelis* came from as high as 14,000 feet. In the surrounding region Dr. Roy C. Andrews found it not uncommon, and secured specimens from the following localities: Chunglu on the Mekong River, 6,000 feet; Hsiaokela, at 8,000 feet; Chiangwei, Shasungshoo, and Yangtsien at from 7,500 to 9,000 feet; Hapa, twenty miles north of Taku, 10,000 feet; and to the south at Tali Lake and Yunnanfu. A single one, practically a topotype, from Yangpi River, 5,000 feet, on the Tengyueh road is the same, and Osgood (1932) has recorded it from Nguluko, Yunnan, and Kulu, Szechwan.

Probably the range as a species extends eastward in southern China to at least the region of the Yangtze Gorge at Ichang, where it is represented by the race *E. miletus aurora* which, though not very different otherwise, seems to be slightly smaller.

The breeding season may extend over a considerable part of the year, for in two cases three embryos were found in specimens taken in the first week of October, and two in a female taken October 30, 1916. The small number of young, as already mentioned, is correlated with the reduced number (four) of mammæ.

Specimens examined.—In all, one hundred and two, as follows:

Yunnan: Likiang, 8,200-9,000 feet, 22; 11, including type of *E. fidelis* (B.M.); Chunglu, Mekong River, 6,000 feet, 7; Hsiaokela, 8,000 feet, 1; Chiangwei, 8,000 feet, 5; Shasungshoo, 7,500 feet, 2; Yangtsien, 9,000 feet, 4; Hapa, twenty miles north of Taku, 10,000 feet, 8; Tomulang, Chungtien district, 10,000 feet, 4; Peitai Mountain, 10,000 feet, 2; Tugansha, Chungtien district, 1; Shihku, Yangtze River, 6,000 feet, 1; Yangpi River, 5,000 feet, 3; Waita, Mekong River, 6,000 feet, 1; Hsiaotien, 6,500 feet, 1; Shangkwan, Tali Lake, 6,500 feet, 3; Miakai, Tali Lake, 2; Litien, 3; Yunnanfu, 14; Wuting, 6; ten miles west of Yangpi, 1, the type (B.M.).

352. *Eothenomys miletus aurora* (G. M. Allen)

Microtus (*Eothenomys*) *aurora* G. M. Allen, Mem. Mus. Comp. Zool., vol. 40, p. 211, fig., 1912.

Eothenomys melanogaster aurora Hinton, Ann. Mag. Nat. Hist., ser. 9, vol. 11, p. 149, 1923.

Type specimen.—An adult male, skin and skull, No. 7788, Museum of

Comparative Zoölogy, from Changyanghsien, Hupeh, China. Collected February 2, 1909, by Walter R. Zappey.

Description.—This subspecies resembles *E. melanogaster* in size and proportions, but in the series of adult skins available, in winter pelage, it is much brighter in color, nearly "hazel" above, with many ochraceous-tipped hairs that give minute brassy reflections, tending to produce a paler, brighter appearance. The under surface of the body is gray, with a buffy wash, and the hairs are everywhere slaty at their bases. Feet, as usual, brownish above, the tail dark brownish black, very slightly lighter in color below.

The skull, like that of *E. miletus miletus*, is at once distinguished from that of typical *E. melanogaster melanogaster* by the fact that the last upper molar has constantly four inner salient angles and three outer ones in the younger as well as in the adult specimens.

Measurements.—The following flesh measurements were published with the original description:

No.	Total length	Tail	Hind foot	Locality
7185 MCZ	145	41	15.0	Hupeh
7186 MCZ	147	48	17.0	Hupeh
7188 MCZ	139	40	16.0	Hupeh
7788 MCZ	148	43	18.5	Hupeh

For cranial measurements, see table under *E. m. miletus*.

Occurrence and Habits.—In the mountain forests of western Hupeh, W. R. Zappey collected a small series of this vole at Changyanghsien, Hsientientze, and Kwongpow, localities in the Ichang region. All agree in their bright coloring and in the structure of the third upper molar with uniformly a well-developed fourth inner salient angle, as in *E. miletus*. In size, however, they are apparently slightly smaller, so that I have retained the name originally given, in a subspecific sense. The presence of a race of *E. miletus* in this region again emphasizes the fact that the distribution of the species is southern, and it may be looked for with confidence in the mountainous country of the southern provinces.

The single specimen from Hsientientze is very young and of a decidedly blackish appearance, as in immature specimens of *E. melanogaster*.

Specimens examined.—Six, as follows:

Hupeh: Changyanghsien, 4 (M.C.Z.); Hsientientze, 1 (M.C.Z.); Kwongpow, 1 (B.M.).

353. *Eothenomys eleusis* (Thomas)

Microtus (Eothenomys) melanogaster eleusis Thomas, Abstr. Proc. Zool. Soc. London, October 31, 1911, p. 50; Proc. Zool. Soc. London, 1912, p. 139.

Eothenomys melanogaster eleusis Hinton, Ann. Mag. Nat. Hist., ser. 9, vol. 11, p. 149, 1923; Monogr. of Voles and Lemmings, vol. 1, p. 286, 1926.

Eothenomys melanogaster confinii Hinton, Ann. Mag. Nat. Hist., ser. 9, vol. 11, p. 151, 1923; Monogr. of Voles and Lemmings, vol. 1, p. 288, 1926. Kiukiang-Salween divide, Yunnan.

Microtus (Eothenomys) melanogaster confinii G. M. Allen, Amer. Mus. Novitates, no. 133, p. 3, 1924.

Eothenomys melanogaster confini Osgood, Publ. Field Mus. Nat. Hist., zool. ser., vol. 18, p. 323, 1932.

Type specimen.—An adult male, skin and skull, No. 11.9.8.111, British Museum, from twenty-one miles east of Chaotungfu, northern Yunnan, China. Collected by Malcolm P. Anderson, March 13, 1911.

Description.—In general outward appearance this vole much resembles the more northern *E. melanogaster*, but the back and sides average a slightly grayer shade, and the belly is usually less blackish, more brown.

The skull differs notably from that of typical *E. melanogaster* in having uniformly a fourth inner salient angle on the posterior upper molar, in this respect resembling *E. miletus*. From the latter, however, the difference in size readily distinguishes it, while the skull is much more flattened and the interparietal is narrower.

Measurements.—The considerably smaller size distinguishes this vole from *E. miletus* with which it is associated, but as the following field measurements of the original series show, the external dimensions are much the same as in *E. melanogaster*, although the tail possibly averages longer.

No.	Head and body	Tail	Hind foot (s. u.)	Ear	Locality
11.9.8.109 BM	92	46	16.5	11.0	Yunnan
11.9.8.110 BM	94	49	16.0	12.0	Yunnan
11.9.8.111 BM (type)	98	55	17.0	11.5	Yunnan
11.9.8.112 BM	93	50	16.0	11.0	Yunnan
11.9.8.113 BM	92	46	17.0	11.5	Yunnan
11.9.8.114 BM	93	47	17.0	11.0	Yunnan
11.9.8.115 BM	92	48	17.5	11.0	Yunnan
11.9.8.116 BM	92	50	18.0	11.5	Yunnan
11.9.8.118 BM	92	48	16.5	11.0	Yunnan
11.9.8.119 BM	90	50	17.0	11.5	Yunnan
22.12.1.1 BM (type of <i>confinii</i>)	106	59	20.0 (?c.u.)	13.0	Yunnan

CRANIAL MEASUREMENTS OF *EOTHENOMYS ELEUSIS*

No.	Greatest length	Basal length	Palatal length	Zygomastic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
11.9.8.109 BM	23.5	21.6	12.7	14.5	11.7	4.9	5.8	5.9	Yunnan
11.9.8.111 BM (type)	24.5	22.8	13.1	14.5	12.3	5.2	5.7	5.7	Yunnan
11.9.8.114 BM	24.2	21.9	12.6	14.1	11.7	4.9	5.9	5.8	Yunnan
11.9.8.115 BM	23.8	—	12.7	14.5	12.0	5.2	6.0	6.5	Yunnan
11.9.8.116 BM	23.8	—	12.2	13.9	11.7	4.8	6.0	6.3	Yunnan
11.9.8.119 BM	24.7	22.6	12.9	14.5	12.5	5.0	6.3	6.5	Yunnan
22.12.1.1 BM (type of <i>confinii</i>)	25.8	23.4	13.6	14.9	11.7	5.6	6.0	6.3	Yunnan

CRANIAL MEASUREMENTS OF *EOTHENOMYS ELEUSIS* (Cont'd)

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
44185	22.5	20.3	12.0	13.1	10.9	4.8	5.5	5.8	Yunnan
44184	23.5	22.0	12.6	14.3	11.0	5.0	5.7	5.6	Yunnan
44195	23.5	21.9	12.5	13.3	11.0	4.7	5.8	5.5	Yunnan
44197	24.2	22.6	13.0	14.1	11.5	5.1	6.0	5.7	Yunnan

Nomenclature.—This vole was originally described by Thomas on the basis of a series taken in March at Chaotungfu, northern Yunnan. He regarded it as a subspecies of *E. melanogaster*, a view that may eventually prove to be correct. Nevertheless, the original series and other specimens from Yunnan differ so consistently in the form of the last upper molar with its additional inner salient that it seems as well at present to give it specific rank until additional collecting shows intermediate conditions. The color of the two animals is much the same, but *E. eleusis* is slightly grayer and longer-tailed. After examining the type and other specimens in the British Museum and comparing them with the type of *E. m. confinii*, it seems evident that these two are really the same, as one might expect from their occurrence in the same general region. The type specimen of the latter is slightly above the average size, as its field measurements indicate, although the measurement given for the hind foot is probably too large, for on the skin it is but 18.3 mm. instead of 20. I am therefore including *E. m. confinii* in the synonymy of *E. eleusis*.

Occurrence and Habits.—Except for its grayer coloring, this species is in many respects a smaller replica of *E. miletus*, which it resembles in tooth pattern, but apparently it does not have the bright rusty-brown coloring of the latter. The two furnish another case of the presence of a larger and a smaller form of the same group in the highlands of western China, such as is offered in the case of *Microtus forresti* and *M. irene*. The range extends from northern Yunnan, where the original series was collected east of Chaotungfu, southward across the Yunnan highlands into northern Indo-China, whence Osgood (1932) has recorded a specimen taken at Chapa. The work of the American Museum Asiatic Expeditions has confirmed its presence as a common species at altitudes of from 6,000 to 12,000 feet in western Yunnan, as at Homushu Pass, Mucheng on the Salween drainage (7,000 feet), Tashuitang (6,000 feet), Hsiaokela, Mekong River, and on Peitai Shan, thirty miles south of Chungtien, at 10,000 feet altitude. A specimen in the British Museum from Tengyueh, although labeled *E. melanogaster*, proves to be this species also.

The number of young in a litter is apparently small, correlated with the reduced number of mammæ (four). Two females collected by the American Museum Asiatic Expeditions on February 8, 1917, contained respectively one

and two embryos. Evidently, too, breeding may continue during the winter months.

Specimens examined.—The following fifty-six:

Yunnan: Tashuitang, 6,000 feet, 2; Homushu Pass, 8,000 feet, 4; Mucheng, 7,000 feet, 33; twenty miles south of Yungchangfu, 2; Peitai Shan, thirty miles south of Chung-tien, 10,000 feet, 1; Hsiaokela, Mekong River, 1; Hsiaotien, 1; Chaotungfu, 11, including the type (B.M.); Kiukiang-Salween divide, 1, type of *E. melanogaster confinii* (B.M.).

Subgenus *Anteliomys* Miller

Anteliomys Miller, North Amer. Fauna, no. 12, p. 47, 1896. G. M. Allen, Amer. Mus. Novitates, no. 133, p. 5, 1924 (as a subgenus of *Microtus*). Hinton, Ann. Mag. Nat. Hist., ser. 9, vol. 11, p. 146, 1923 (as a genus). Osgood, Publ. Field Mus. Nat. Hist., zool. ser., vol. 18, p. 321, 1932 (as a subgenus of *Eothenomys*).

The chief characters distinguishing this group are of a relative nature, rather than sharply defined. According to Hinton (1926), who would give it full generic rank, it is nearest related to *Eothenomys*, but differs chiefly in the "tendency to approximation in the interorbital region shown by the temporal ridges and the anterior portions of the squamosals, characters which betoken increased development of the anterior portions of the temporal muscles; and by the greater size and complexity of the m^3 ." In the last character, however, the gap is more or less bridged by such species as *E. proditor* and *E. custos*. Thomas (1912b) wrote that "*Eothenomys*, *Anteliomys*, and *Caryomys* are all much more closely allied to each other than has hitherto been recognized, and it is really only by the open or closed state of certain of the tooth-spaces and by the simple or complex condition of m^3 that they can be distinguished from each other." To express such interosculating relationships in nomenclature is difficult, for a uniform treatment in which other related groups are given due emphasis becomes more or less out of the question. For the present therefore it may be as well to regard *Anteliomys* as a subgenus of *Eothenomys*, which it resembles in its mammary formula, with two inguinal pairs of mammae only. The type species is *Microtus chinensis* Thomas. Six forms, representing probably but two species, have been described, all of which are found, so far as yet known, within the limits of southwestern China. The palate ends in a transverse shelf as in *Clethrionomys*, but is slightly produced backward as a short median projection, a condition often seen in typical *Eothenomys* as well. In the lower molars there are no closed triangles, but they are arranged in more or less opposite pairs, with their bases widely confluent. The upper molars may have all the triangles of the first and second closed, or occasionally somewhat confluent, while the third molar is remarkable for its length of heel. It consists of a transverse space with a shallow notch on its outer edge separating off two outer angles, then comes a deep outer reëntrant that reaches to the opposite enamel wall and thus cuts off two closed triangles; behind this the long

heel of the tooth has two or three inner and one or two outer projections of varying size. The claws of the hind feet are slightly longer and stouter than those of the fore. The fur has burnished tips as in the typical *Eothenomys* group.

354. *Eothenomys olitor* (Thomas)

Microtus (*Eothenomys*) *olitor* Thomas, Abstr. Proc. Zool. Soc. London, October 31, 1911, p. 50; Proc. Zool. Soc. London, 1912, p. 139.

Eothenomys olitor Hinton, Ann. Mag. Nat. Hist., ser. 9, vol. 11, p. 149, 1923; Monogr. of Voles and Lemmings, vol. 1, p. 292, 1926.

Type specimen.—An adult female, skin and skull, No. 11.9.8.122, British Museum, from Chaotungfu, altitude 6,700 feet, western Yunnan, China. Collected March 19, 1911, by Malcolm P. Anderson.

Description.—A small, dark-brown species, with simplified first upper molar and more complicated last upper molar as compared with *E. melanogaster* which it rather resembles externally. The coloration is almost identical with that of the darker individuals of typical *E. melanogaster*, so that the identification of specimens must rest upon an examination of the teeth. The very small ears, however, are strikingly black, forming a contrast to the dorsal surface, which is a uniform dark brown, nearest "seal brown" of Ridgway, relieved by a minute ticking of ochraceous-tipped hairs, the ends of which are burnished and from certain angles become conspicuous by reflecting the light. Under side dark slaty, with the tips of the hairs more or less shining in accordance with the incidence of light. Backs of feet and the tail all around, dark brown.

The skull is remarkably small, delicate and flattened dorsoventrally in comparison with that of other members of the genus. In profile view the upper outline is very little convex, and there is an indication of a low ridge along the outer edge of the parietals, marking the upper limit of the temporal muscles. In its tooth pattern the upper molars nearly bridge the gap between the patterns of *Eothenomys* and *Antelionomys*, having the simplified first molar and complex last molar of the latter, but the marked confluence of the inner and outer spaces of the first tooth as in the former. There are three inner and three outer salient angles to the first upper molar, which therefore consists of a transverse prism followed by two pairs of nearly opposite triangles, in which the bases of each pair are broadly confluent. The second molar is similar, except that the last pair of triangles is almost exactly opposite, and the tooth is therefore nearly bilaterally symmetrical. The third upper molar has three deep inner reëntnants and three shallow outer ones, so that there are four projecting angles on each side. Both these last two molars have a certain amount of cement filling in the reëntnants. The lower molars are essentially similar to those of other members of the genus.

Measurements.—The following measurements are from the fresh specimens, as entered on the labels by the collectors:

No.	Head and body	Tail	Hind foot	Ear	Locality
44191	80	29	14.0	—	Yunnan
11.9.8.121 BM	83	31	15.5	10.5	Yunnan
11.9.8.122 BM (type)	82	34	16.0	9.0	Yunnan
11.9.8.123 BM	88	38	15.5	10.0	Yunnan
11.9.8.124 BM	82	33	16.0	10.0	Yunnan
11.9.8.125 BM	86	35	16.0	10.0	Yunnan
11.9.8.126 BM	90	39	17.0	11.0	Yunnan
11.9.8.127 BM	92	34	16.0	10.0	Yunnan

CRANIAL MEASUREMENTS OF *EOTHENOMYS OLITOR*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
44191	20.9	19.5	11.6	13.0	9.8	4.5	5.1	5.2	Yunnan
11.9.8.122 BM (type)	23.7	22.1	12.5	14.0	10.4	4.9	5.7	5.7	Yunnan
11.9.8.123 BM	22.6	21.2	12.5	13.7	11.2	5.1	5.5	5.9	Yunnan
11.9.8.121 BM	—	—	12.2	14.2	—	5.1	5.7	6.1	Yunnan
11.9.8.124 BM	22.8	21.3	12.1	13.7	11.5	5.1	5.8	5.8	Yunnan

Occurrence and Habits.—The few specimens of this species hitherto known indicate that it is a strikingly distinct animal characterized by its small size, flattened, delicate skull, and peculiar tooth pattern, as well as externally by its coloring of dark olive brown ticked with ochraceous, slaty-gray belly, and rather sharply contrasted black ears. So far as known it is confined to the high country of western Yunnan where, in addition to the original series taken at Chaotungfu, Dr. R. C. Andrews's expedition secured specimens at altitudes of from 6,000-7,000 feet at Mucheng, Salween drainage, and farther north at Peitai, twenty miles south of Chungtien.

According to M. P. Anderson, who collected the type and others at Chaotungfu, it was found "in the open fields of the little cultivated plain surrounding the city."

Specimens examined.—The following twelve:

Yunnan: Mucheng, Salween drainage, 6,000-7,000 feet, 4; Peitai, thirty miles south of Chungtien, 1; Chaotungfu, 7, including the type (B.M.).

355. *Eothenomys proditor* Hinton

Eothenomys proditor Hinton, Ann. Mag. Nat. Hist., ser. 9, vol. 11, p. 152, 1923; Monogr. of Voles and Lemmings, vol. 1, p. 291, 1926.

Microtus (Eothenomys) proditor G. M. Allen, Amer. Mus. Novitates, no. 133, p. 4, 1924.

Type specimen.—An adult male, skin and skull, No. 22.12.1.10, British Museum, from Likiang Range, altitude 13,000 feet, western Yunnan, China. Collected May 27, 1921, by George Forrest.

Description.—Externally this species is hardly distinguishable from *E. miletus* inhabiting the same country; the teeth, however, are transitional in character to *Antelionmys*, especially in the complexity of the last upper molar. The entire dorsal surface of the head and body is about mummy brown to russet in general tone, the individual hairs slaty at the base with a broad ochraceous tip, or entirely black. The lower surface is slate-color, most of the hairs with pale-gray tips washed with buff. Backs of the feet blackish brown. Tail similar or slightly paler below. The longer hairs on both surfaces of the body show the usual shiny tips characteristic of the genus.

The skull is fairly large and heavy for the genus, in this respect resembling that of *E. miletus*, with a broad interorbital space, showing little or no encroachment of muscle ridges. The teeth are the most characteristic feature. The first upper molar consists of a transverse space followed by two pairs of triangles so nearly opposite that their bases are partly confluent; there are thus three outer and three inner salient angles. The second molar has, in addition to the anterior transverse prism, an outer and an inner triangle, the latter slightly more posterior and narrowly confluent with the first, and finally a third outer triangle, so that there are three outer and two inner salient angles. The third molar is especially characteristic. On its outer side there is first a shallow reëtrant of the enamel, then a deep one projecting backward and inward, followed by a second shallow notch. On the inner side of the tooth there are two deep notches of equal length, somewhat squarish in outline at the inner anterior margin. There are thus four outer and three inner projections to this tooth. The first lower molar has the usual anterior trefoil with two inner projections followed by two pairs of triangles, the outer and inner of each pair broadly confluent. These patterns are illustrated by Hinton (1926, pp. 282, 283).

Measurements.—As pointed out by Hinton, the tail is considerably shorter in this species than in the large *E. m. miletus*, a good distinguishing character. The following are measurements from the fresh specimens:

No.	Head and body	Tail	Hind foot	Ear	Locality
44069	110	32	20	—	Yunnan
44821	—	26	18	—	Yunnan
22.12.1.13 BM	110	29	18	12	Yunnan
23.10.11.1 BM	108	33	19	13	Yunnan
23.10.11.3 BM	105	31	19	12	Yunnan
23.10.11.6 BM	110	27	18	13	Yunnan
23.10.11.8 BM	108	28	18	13	Yunnan
23.10.11.9 BM	105	30	17	12	Yunnan
23.10.11.10 BM	115	34	19	16	Yunnan
23.10.11.11 BM	110	31	17	13	Yunnan

CRANIAL MEASUREMENTS OF *EOTHENOMYS PRODITOR*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
44067	25.8	24.1	13.6	15.7	12.3	5.5	5.9	6.6	Yunnan
44821	27.9	25.3	14.7	15.8	12.4	5.5	5.9	6.1	Yunnan
22.12.1.10 BM (type)	27.3	25.6	14.6	16.3	12.1	5.6	6.5	6.6	Yunnan
22.12.1.12 BM	25.4	23.8	13.6	14.7	11.9	5.3	6.0	6.1	Yunnan
22.12.1.13 BM	26.0	24.2	14.3	14.6	—	5.4	6.5	6.2	Yunnan
22.12.1.16 BM	27.0	25.4	14.6	16.6	12.4	5.7	6.5	6.6	Yunnan
23.10.11.2 BM	26.2	—	13.7	15.4	11.7	5.3	6.2	6.0	Yunnan
23.10.11.3 BM	25.9	24.4	13.8	15.5	12.5	5.1	6.4	6.2	Yunnan
23.10.11.6 BM	—	23.4	13.9	15.7	12.5	5.4	6.0	6.3	Yunnan

In the type skull the third upper molar has a very small fourth outer projection. The first outer infold is, as usual in the subgenus, too shallow to cut off a triangle, but the next or first inner triangle is completely closed, as well as the next or outer one. The heel of the tooth is a long spatulate lobe with a good-sized inner angular projection and a minute outer one.

Occurrence and Habits.—This is a very interesting species because of the annectant characters it shows between the subgenera *Eothenomys* and *Anteliomys*. Externally it is chiefly distinguishable from the large *E. m. miletus* of the same general region by its shorter tail, although in color it is nearly identical. The pattern of the last upper molar is characteristic, with its three outer reëntnants, a shallow notch, a deep notch and a shallow one again. In this it is essentially like *Anteliomys*, which, however, usually has an additional projection. It is again peculiar in that the second upper molar has a well-marked third projection on the inner side, a condition more usual in *Anteliomys*. Evidently the two groups have not diverged very far, and Dr. Osgood would regard *E. miletus* as a member of the subgenus *Eothenomys*.

The range of this species, so far as at present made out, is rather circumscribed. It has been taken mostly on the higher levels of the Likiang Range. Dr. R. C. Andrews found it here at 12,000 feet on Ssu Shan; at 9,000 feet on Ssushanchang; on Peishui at 10,000 feet. Osgood (1932) records it from twenty-five miles north of Likiang and from Nguluko in Yunnan, and makes the first Szechwan record on the basis of two from Itze and two others from Kulu in that province. Thomas suggests that on the higher parts of the Likiang Range this species and perhaps *E. olitor* occupy the niche filled to the northward by *Neodon* which seems absent from this isolated mountain mass. The timber-line at 13,000 feet is the highest level at which this species has been found.

Nothing is recorded of the habits. Forrest found it common in open, rocky alpine meadows.

Specimens examined.—In all, nineteen skins and skulls, and fifteen alcoholics, as follows:

Yunnan: Likiang Range, Ssushanchang, 9,000 feet, 4 skins, 15 alcoholics; Ssu Shan, 12,000 feet, 2; Peishui, 10,000 feet, 3; and one from timber-line, 13,000 feet; Likiang Range, 11,000 to 13,000 feet, 9, including the type (B.M.).

356. *Eothenomys chinensis chinensis* (Thomas)

Microtus chinensis Thomas, Ann. Mag. Nat. Hist., ser. 6, vol. 8, p. 117, 1891.

Microtus (Antelomys) chinensis Miller, North Amer. Fauna, no. 12, p. 49, 1896 Thomas, Proc. Zool. Soc. London, 1911, p. 175.

Antelomys chinensis chinensis Hinton, Monogr. of Voles and Lemmings, vol. 1, p. 296, 1926

Type specimen.—An adult female, in alcohol, No. 91.5.11.3, British Museum, from Kiatingfu, Szechwan, China. Collected by A. E. Pratt.

Description.—Of about the size and appearance of a common meadow mouse externally, but the tail proportionally long, exceeding half the head-and-body length and about equaling the body without the head. General color above, a grayish brown, nearly "Prout's brown" of Ridgway, the individual hairs as usual dark slaty at their base, many with black tips, but more with shining ochraceous tips that give a brassy reflection in certain lights. Throat, under surface of limbs and the inguinal region, bluish gray with minute pale-whitish tips; central region of the belly conspicuously washed with pinkish buff. Backs of the feet thinly clothed with grayish hairs, some with dark bases. Tail black above, slightly paler below, the hairs so short that the rings of scales are apparent on close examination.

The skull though fairly large is light and thin of bone, and the ear bullæ lack the spongy trabeculæ of bone. Two lengthwise ridges are very faintly marked, one on each side of the interorbital region. The first and second upper molars have each an anterior transverse space followed by two outer closed spaces, making three salients each on the outer side. On the inner side, however, the first molar has two closed spaces, the second only one. These are rounded rather than sharply angular. The last upper molar has a shallow outer notch, then a deep one, followed by a second shallow notch and sometimes one or two additional slight indentations. Only the deep second reëntrant extends across to the opposite enamel wall, and thus cuts off two closed triangles, an inner and an outer. On the inner side of the tooth are three deep reëntrants, and in some specimens a fourth shallower one, making five projections on each side of the tooth. In the first lower molar there is a transverse posterior space,

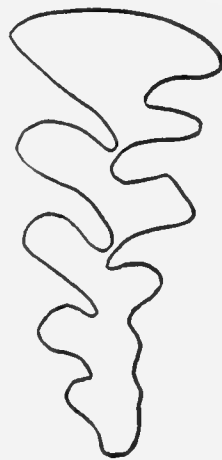


FIG. 34. *Eothenomys chinensis chinensis*, outline of last upper molar (from the type, No. 91.5.11.3, British Museum). Much enlarged.

with in advance of it two opposite pairs of triangles widely open and confluent at their bases, and an anterior trefoil of which the outer petal is a short recurved hook, while on the inner side is a well-developed triangular space slightly open at the base.

Measurements.—The following field measurements were made by the collector (no ear measurements recorded):

No.	Head and body	Tail	Hind foot	Locality
7805 MCZ	110	65	22.0	Szechwan
7808 MCZ	111	64	24.0	Szechwan
7809 MCZ	112	63	22.0	Szechwan
7812 MCZ	109	69	23.0	Szechwan
7813 MCZ	109	68	22.5	Szechwan
7814 MCZ	118	63	22.0	Szechwan
7815 MCZ	116	69	22.0	Szechwan
7816 MCZ	125	69	22.0	Szechwan
7818 MCZ	107	65	19.0	Szechwan
7820 MCZ	121	65	22.0	Szechwan
7822 MCZ	112	66	21.0	Szechwan

CRANIAL MEASUREMENTS OF *EOTHENOMYS CHINENSIS*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
<i>E. chinensis chinensis</i>									
7805 MCZ	27.4	24.5	13.8	15.0	12.1	5.3	6.6	6.8	Szechwan
7806 MCZ	26.0	23.8	13.6	14.3	12.2	5.5	6.3	6.6	Szechwan
7807 MCZ	26.0	23.7	13.3	14.5	12.0	5.1	6.2	6.1	Szechwan
7808 MCZ	28.7	24.8	14.2	15.0	12.8	5.2	6.5	6.1	Szechwan
7809 MCZ	27.5	24.4	14.0	15.5	12.7	5.7	6.6	6.3	Szechwan
7812 MCZ	28.0	25.6	14.0	15.9	13.5	5.8	6.5	6.6	Szechwan
7814 MCZ	27.4	25.8	14.3	15.5	12.6	5.5	6.4	6.0	Szechwan
7815 MCZ	27.0	25.0	14.1	15.8	13.0	5.5	6.3	6.6	Szechwan
7819 MCZ	26.8	24.6	13.7	15.5	13.0	5.6	6.3	6.2	Szechwan
7820 MCZ	27.7	25.8	14.5	15.2	13.0	5.8	6.2	6.2	Szechwan
91.5.11.3 BM	28.6	26.2	14.7	15.7	13.0	5.1	6.5	6.6	Szechwan
<i>E. chinensis tarquinius</i>									
11.2.1.202 BM	27.7	25.5	14.1	15.5	13.0	5.9	6.6	6.7	Szechwan
11.2.1.209 BM	28.3	25.7	14.7	15.9	13.7	5.6	6.5	6.5	Szechwan
11.2.1.217 BM	27.7	25.9	14.5	15.4	13.0	5.6	6.6	6.5	Szechwan
11.2.1.219 BM	27.2	24.8	13.8	15.6	12.6	5.5	6.7	6.6	Szechwan
<i>E. chinensis wardi</i>									
22.10.21.6 BM	27.7	26.0	14.6	15.5	12.7	5.5	6.5	6.3	Yunnan
22.10.21.11 BM	27.4	25.5	14.1	15.5	12.2	5.5	6.3	6.5	Yunnan
14.10.23.30 BM	26.0	24.1	13.7	14.5	11.8	5.4	6.0	5.7	Yunnan
14.10.23.24 BM	25.6	24.0	13.6	14.5	12.0	5.2	6.0	6.5	Yunnan
12.3.18.15 BM	27.0	25.1	14.6	15.4	12.2	5.3	6.0	6.5	Yunnan

Nomenclature.—This vole is characterized by the great development of the last upper molar, which, nevertheless, shows more or less variation in the number of projections or minor enamel folds. Thus, of thirteen skulls regarded as representing typical *E. c. chinensis*, all from Wa Shan, less than fifty miles from the type locality, six have five and another six have four salient angles on the inner side of this tooth, while the thirteenth is intermediate, with a very small projection at the posterior corner. Moreover, the condition of closure of some of the triangular spaces, or the development of a minute inner posterior point on the last molar, may vary on opposite sides of the same skull. It therefore becomes in part a matter of opinion how far it is possible to recognize local races on the basis of some of these characters. Nevertheless, after examining the series in the British Museum that served as the basis of Thomas's description of the race *tarquinius* from near Tatsienlu, it appears that they are uniformly different from the series farther east in slightly less complication of this tooth. In the type the first outer reëntrant is deep enough to reach across to the opposite enamel wall, and this seems to be the usual condition (in six out of seven skulls); again, the series agrees in having the second and third enamel triangles completely closed instead of more or less confluent; and finally, the heel of the tooth is usually shorter, with four projections on each side instead of five or even six. I have therefore decided to recognize *E. c. tarquinius* as an upland race of western Szechwan. *Microtus wardi* of Thomas is very closely related also, but seems to be different in its decidedly smaller bullæ and obviously flatter skull. I am therefore considering it as a geographic race of extreme northwestern Yunnan.

Occurrence and Habits.—This long-tailed vole might easily be mistaken for *E. (Caryomys) inez* from its external appearance alone, but it is larger and more heavily washed below with dull ruddy brown, while the characters of the tooth pattern are distinctive. It is apparently a common species in the higher country of central Szechwan, in wooded areas, from an altitude of 6,000 to as high as 10,000 feet. The type was taken from the stomach of a snake, *Trimeresurus jerdoni*, at Kiating, Szechwan. Later Thomas recorded it from Omei Shan, and W. R. Zappey secured a series of twenty-one from Wa Shan, a high mountain mass some forty miles southwest of the type locality. These last were taken in dense thickets of rhododendron from the lower slopes at 6,000 feet to near the summit, 10,000 feet. No doubt the species will later be found in the mountainous parts of Kweichow and adjacent regions. To the west intergradation with the following subspecies is to be looked for.

Specimens examined.—The following thirty:

Szechwan: Wa Shan, 21 (M.C.Z.); Omei Shan, 8 (B.M.); Kiatingfu, 1, the type (B.M.).

357. *Eothenomys chinensis tarquinius* (Thomas)

Microtus (Antelomys) chinensis tarquinius Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 9, p. 517, 1912.
Antelomys chinensis tarquinius Hinton, Monogr. of Voles and Lemmings, vol. 1, p. 296, 1926.

Type specimen.—The type is an adult male, skin and skull, No. 11.2.1.207, British Museum, from twenty-three miles southeast of Tatsienlu, Szechwan (now Hsikang), China, 10,000 feet altitude. Collected by Malcolm P. Anderson, June 15, 1910.

Description.—Externally this vole is indistinguishable from the typical

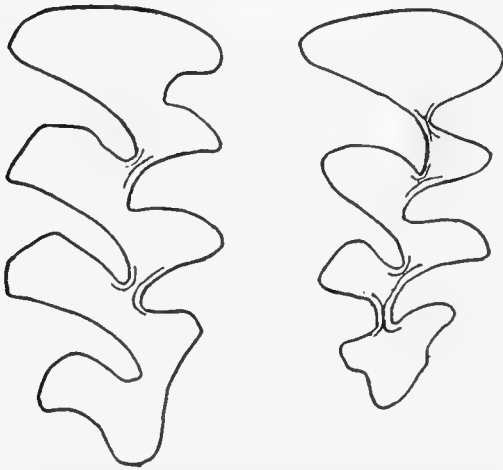


FIG. 35. *Eothenomys chinensis tarquinius*, approximate outlines of the last upper molar in the type (right), No. 11.2.1.207, British Museum, and a topotype (left), Tatsienlu. Much enlarged.

race of central Szechwan, but may be recognized on the basis of tooth characters. As mentioned under *E. c. chinensis*, the series of topotypes in the British Museum differs in having (six out of seven specimens) the first outer reentrant of the last upper molar wider and deeper, so that it reaches the opposite enamel wall, cutting off a small outer triangle, while the second (inner) and third (outer) triangles are also (with one exception) completely separated by the second outer reentrant, instead of being left narrowly confluent. Moreover the heel of the tooth is less complex than the usual condition in typical *E. c. chinensis*, with two inner lobes in addition to one outer one following the

second and third triangles, so that there are four projections on each side of the tooth instead of five or even six, if the more minute ones are counted.

Measurements.—In external dimensions this race is quite the same as the typical form. Two topotypes from Tatsienlu in the British Museum were measured by the collector as follows:

No.	Head and body	Tail	Hind foot	Ear
11.2.1.209 BM	101	70	22	15
11.2.1.212 BM	102	76	23	15

For cranial measurements, see table under *E. c. chinensis*.

Occurrence and Habits.—This western race is known from the type locality only, some few miles southeast of Tatsienlu, that is, along the edge of the more barren uplands bordering the Tibetan plateau. Probably it will be found to extend a short distance eastward, intergrading with the typical subspecies,

while still farther to the southwest the flatter-skulled race *E. c. wardi* occurs near the Burma border. Possibly *E. c. tarquinius* in its simpler tooth pattern represents a somewhat more primitive type associated with more rigorous conditions of existence than the more eastern animal with the more complex structure of the last upper molar.

Specimens examined.—The original series from Szechwan (now Hsikang): Tatsienlu, 7, including the type (B.M.).

358. *Eothenomys chinensis wardi* (Thomas)

Microtus (Anteliomys) wardi Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 9, p. 516, 1912; *ibid.*, vol. 14, p. 473, 1914.

Anteliomys wardi Hinton, Ann. Mag. Nat. Hist., ser. 9, vol. 11, p. 154, 1923; Monogr. of Voles and Lemmings, vol. 1, p. 298, 1926.

Type specimen.—A skull of an adult male, No. 12.3.18.15, British Museum, from Chamutong, upper Salween drainage area, west of Atuntze, northwestern Yunnan, 13,000 feet altitude. Collected by F. Kingdon Ward.

Description.—Externally specimens of this race are quite like the typical form of central Szechwan, but their skulls are markedly more flattened, while a still better character is the noticeably smaller size of the audital bullæ. The last upper molar is practically as in *E. c. chinensis*. To illustrate the difference between the two races, the type skull of the latter measures: greatest depth through the bulla, 9.7 mm.; greatest length of bulla diagonally, 9.1; greatest width, 5.7; in the type of *E. c. wardi* these measurements are, respectively, 9.2, 6.7, 4.5. The position of the lateral gland is marked by a slightly darker spot.

Measurements.—In size of body this race is practically like the typical subspecies, as the following field measurements show:

No.	Head and body	Tail	Hind foot	Ear	Locality
14.10.23.27 BM	110	66	20	15	Yunnan
14.10.23.30 BM	107	59	19	14	Yunnan

Occurrence and Habits.—As Hinton remarks, this race is "widely distributed in the high alpine meadows" of northwestern Yunnan where it is perhaps more of a dweller in burrows or among rocks than the forest-living race of central Szechwan, and so has a more flattened skull. Although hitherto considered as a distinct species, there seems to be no reason to doubt its closer relationship to *E. chinensis*. In addition to specimens from the upper Salween drainage area west of Atuntze, the British Museum has others from the Kiukiang-Salween divide, 12,000-14,000 feet; Siha Pass, 14,500 feet, and from the Mekong valley as low as 8,000-9,000 feet. Nothing is recorded of its habits.

Specimens examined.—The following seventeen:

Yunnan: Mekong-Salween divide, 10, including the type (B.M.); Mekong valley, 3 (B.M.); Kiukiang-Salween divide, 3 (B.M.); southwest side of Siha Pass, 1 (B.M.).

359. *Eothenomys custos custos* (Thomas)

Microtus (Anteliomys) custos Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 9, p. 517, 1912.

Anteliomys custos custos Hinton, Monogr. of Voles and Lemmings, vol. 1, p. 299, 1926.

Type specimen.—An adult male, skin and skull, No. 12.3.18.19, British Museum, from Atuntze, northwestern Yunnan, China, altitude 11,500-12,500 feet. Collected May 28, 1911, by F. Kingdon Ward.

Description.—This is a smaller species than *E. chinensis*, the range of which it overlaps, and may be distinguished externally by its smaller hind foot and shorter tail. General color above near "burnt umber," the nape and back a ruddy brown mixed with black, the sides of the muzzle slightly grayer. Lower side blue-gray at the base of the hairs, their tips pale whitish or pale ochraceous buff, producing a buffy wash over the chest and belly. Backs of the feet dark brown, with a few paler hairs. Tail bicolor, blackish above, whitish below.

The skull is much like that of *E. chinensis* but smaller; the palate does not end in a median point but usually in a nearly transverse bony shelf with two slight projections one on each side of the median line. The nasals usually slightly exceed in backward extent the ascending processes of the premaxillaries. The pattern of the upper molars is essentially similar to that of *E. chinensis*. In one specimen, however, the first and second upper molars have developed a small postero-internal additional cusp projecting from the inner edge of the tooth. Although the skull somewhat resembles that of *E. olitor*, the two are quite distinct, and may be readily identified by the fact that the ears of *E. custos custos* are about twice the size of those of *E. olitor* and tawny instead of black. The general color of *E. c. custos* is brighter also, a bright tawny.

Measurements.—Field measurements of fresh specimens are:

No.	Head and body	Tail	Hind foot	Ear	Locality
44039	81.0	38.0	17.0	—	Yunnan
44202	92.0	44.0	18.0	—	Yunnan
44205	92.0	40.0	17.5	—	Yunnan
44206	97.0	47.0	18.0	—	Yunnan
12.3.18.16 BM	102.0	47.5	16.5	8.0	Yunnan
12.3.18.19 BM (type)	101.5	40.0	17.0	12.5	Yunnan
12.3.18.20 BM	104.5	48.0	16.5	12.0	Yunnan
12.3.18.22 BM	105.0	40.0	17.0	12.5	Yunnan

CRANIAL MEASUREMENTS OF *EOTHENOMYS CUSTOS*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
<i>E. custos custos</i>									
44039	22.2	19.7	11.5	12.5	10.4	4.7	5.3	5.5	Yunnan
44202	23.7	—	12.0	14.1	11.1	5.0	5.8	5.7	Yunnan
44205	23.1	21.8	12.1	13.2	10.9	5.0	5.7	5.7	Yunnan
44296	23.7	21.7	12.2	13.8	11.2	5.0	5.8	5.8	Yunnan
12.3.18.17 BM	23.4	21.7	12.6	—	11.3	4.9	5.7	5.5	Yunnan
12.3.18.18 BM	23.7	21.5	12.3	13.8	11.3	4.8	5.3	5.7	Yunnan
12.3.18.19 BM (type)	25.0	23.1	12.8	14.5	11.7	5.3	6.3	6.2	Yunnan
12.3.18.23 BM	23.6	21.8	12.0	14.0	11.4	4.8	5.8	5.5	Yunnan
14.10.23.31 BM	24.0	22.2	12.6	13.7	11.5	4.9	5.4	5.7	Yunnan
<i>E. custos rubellus</i>									
44002	24.8	23.0	12.8	15.2	11.7	5.0	6.2	6.5	Yunnan
44181	24.6	22.3	12.9	14.1	11.4	4.7	5.8	5.7	Yunnan
44157	23.7	22.4	12.5	14.5	11.4	5.1	6.1	5.8	Yunnan
44001 (type)	24.5	—	13.1	14.2	11.0	—	6.1	5.9	Yunnan
<i>E. custos hintoni</i>									
(type)	—	—	—	14.4	11.4	—	5.5	—	Szechwan

Occurrence and Habits.—Typical *E. custos* seems to be known from the extreme northwest part of Yunnan only, if the two subspecies following are accepted. The original specimen came from Atuntze, and Dr. R. C. Andrews brought back a small series from near the same locality, namely, from Tomulang and Tugansha in the Chungtien district, and slightly farther south from Yinpankai and Lachumi at altitudes of from 9,000 to 10,000 feet. In one of the eighteen specimens the first and second upper molars have an incipient inner cusp at the posterior end, as sometimes occurs in *E. chinensis*. It will be seen from the measurements, however, that the tail is proportionately shorter in typical *E. custos*, being about one-half the length of head and body.

This is a forest-dwelling species, to some extent at least. Ward notes on the labels of his series that they were taken "under the roots of big trees in very damp forest" or on a "forested bank; in holes under trees with runs under the moss."

Specimens examined.—In all, twenty-seven, as follows:

Yunnan: Tomulang, Chungtien district, 10,000 feet, 13; Tugansha, twenty miles south of Chungtien, 2; Yinpankai, Mekong River, 9,000 feet, 2; Lachumi, 9,000 feet, 1; Atuntze, 9, including the type (B.M.).

360. *Eothenomys custos rubellus* (G. M. Allen)

Microtus (Antelionomys) custos rubellus G. M. Allen, Amer. Mus. Novitates, no. 133, p. 5, 1924.

Antelionomys custos rubellus (sic) Hinton, Monogr. of Voles and Lemmings, vol. 1, p. 299, 1926.

Eothenomys (Antelionomys) custos rubellus Osgood, Publ. Field Mus. Nat. Hist., zool. ser., vol. 18, p. 322, 1932.

Type specimen.—An adult female, skin and skull, No. 44001, American Museum of Natural History, from Ssu Shan (Snow Mountain), Likiang Range, Yunnan, China, at timber line, 13,000 feet. Collected October 13, 1916, by Dr. Roy C. Andrews and Edmund Heller.

Description.—Similar in general to typical *E. custos*, but slightly more reddish above, the belly nearly clear gray, lacking the decided brownish wash. General coloration above, a dull rusty brown, nearly uniform, though slightly clearer along the flanks. The hairs are slaty at the base, with an ochraceous terminal portion that becomes more rufous near the tip, which may be minutely black. Many all-black hairs are mixed with these. At the sides the minute black tips are lacking, giving a clearer rusty. Entire lower surface of the body gray or bluish gray, rarely with a very faint wash of brownish on the chest. Feet and tail drab brown above, the tail whitish below.

The skull is a very little larger on the average than in typical *E. custos*. In the specimens examined the posterior extension of the premaxillaries surpasses the proximal ends of the nasals, but Hinton (1926) points out that this is not constant. The teeth are essentially as in typical *E. custos*.

Measurements.—The following are the collectors' measurements from the fresh specimens:

No.	Head and body	Tail	Hind foot	Ear	Locality
44006	103	35	18.0	14	Yunnan
44121	100	41	17.5	—	Yunnan
44151	95	38	17.5	—	Yunnan
44157	95	40	17.5	—	Yunnan
44161	98	43	18.0	—	Yunnan
44002	100	44	18.5	—	Yunnan

For cranial measurements, see table under *E. custos custos*.

Occurrence and Habits.—So far as yet ascertained, this race occurs on the high peaks of the Likiang Range and in the loop of the Yangtze, where at altitudes of from 9,000 to 13,000 feet Dr. Andrews and Heller found it fairly common near the timber-line. Osgood (1932) has recently referred other specimens to this race from Lutzulu, bend of Yangtze River; Nguluko, and localities twenty-five, forty-five, and sixty miles north of Likiang. Several of these specimens, taken in spring, are lighter in color, "probably bridging any supposed color difference between *custos* and *rubellus*," although the clear gray of the belly seems more or less distinctive. Apparently the larger *E. chinensis* does not extend so far south, although it occurs with typical *E. custos* in

northern Yunnan. Four examples from Taku Hills just east of the Yangtze in the same region are also considered as representing this race.

Specimens examined.—In all, seventy-three, as follows:

Yunnan: Likiang, 13,000 feet, Ssu Shan, 64; Peishui, 10,000 feet, 5; Taku Hills, 4.

361. *Eothenomys custos hintoni* Osgood

Eothenomys (Antelionomys) custos hintoni Osgood, Publ. Field Mus. Nat. Hist., zool. ser., vol. 18, p. 321, 1932.

Type specimen.—An adult female, skin and skull, No. 33073, Field Museum of Natural History, from Wushi, southwest of Tatsienlu, Szechwan (now Hsikang), China. Collected May 15, 1929, by Herbert Stevens.

Description.—Similar to *E. custos custos*, but slightly larger (hind foot 18-20 mm.) and the tail longer, about two-thirds the length of head and body. The last upper molar with four inner and four outer angles.

Color above as in *E. custos* and *E. chinensis*, but the feet paler. "Upper parts grayish washed heavily with Wood Brown medially, this in some cases extending to sides; fore and hind feet drabish white; tail dusky above and definitely lighter below; muzzle pale drabish brown."

The skull is "slightly larger than in *custos*, but much smaller than in *chinensis*"; nasals short, exceeded by the ascending processes of the premaxillaries; the first and second upper molars show no tendency to develop an additional postero-internal angle.

Measurements.—Osgood gives for the "average of ten topotypes measured by the collector: total length 150.7 (147-158); tail 55.2 (51-59); hind foot 19.4 (19-20). Skull of type: condylo-basal length 24.8; zygomatic width 14.4; interorbital constriction 4.2; occipital width 11.4; . . . upper molar series (crowns) 5.5."

Occurrence and Habits.—This is not a very strongly marked race, but perhaps in its slightly longer tail and paler feet may stand as an eastern representative of *E. custos*, carrying the range of the species to central Szechwan, and thus paralleling the distribution of the races of *E. chinensis*. It is thus far known only from the type locality, Wushi, southwest of Tatsienlu. Its range seems to meet that of *E. chinensis*, or nearly so.

Specimens examined.—None.

Subgenus *Caryomys* Thomas

Caryomys Thomas, Abstract Proc. Zool. Soc. London, February 14, 1911, p. 4; Proc. Zool. Soc. London, 1911, p. 175 (subgenus of *Microtus*).

This small group, with two species and two subspecies, has a palate structure essentially as in *Eothenomys* and *Clethrionomys*, with rather simple tooth pattern. Indeed the structure of the molars so far resembles that in the

Clethrionomys rufocanus group that Hinton (1926) finally decided to place the four described forms as synonyms of the latter, but, as A. B. Howell (1929) later insisted, they are unquestionably of distinct species. The coloration, although approaching that of a dull Red-backed Mouse, is quite different, with the fur characteristically finer and softer, more *Microtus*-like, and the tail longer in proportion than in that animal. Again, the pattern of the molars, although closely like that of *Clethrionomys rufocanus*, is nevertheless distinguished by its more sharply angular outer prisms, while the inner ones, shorter and slightly rounded off internally, have their long axis at a considerably sharper angle to the line of the tooth row, as it is in the typical microtines. The exact value of *Caryomys* in relation to allied groups is rather difficult to estimate as it is so nearly annectant between the red-backed mice of the genus *Clethrionomys* and *Microtus* proper. Thomas regarded it as a subgenus of the latter group, comparing it with *Eothenomys* in its external and general cranial characters. He pointed out, however, that the molars have the triangles nearly all closed, instead of mostly open and connected with one another, with the "additional postero-internal lobes on m^1 and m^2 reduced to minute and scarcely perceptible projections." The palatal structure seems to indicate a closer approach to the latter group, of which I therefore propose to consider it a subgenus. A further point of resemblance is that the audital bullæ lack the thick layer of bony trabeculæ seen in *Microtus*. The molars are rootless, as in *Microtus*, while a second noticeable point is the narrowness of the incisors which have a tendency to develop a faint shallow groove on their inner border in the upper jaw. In young individuals the triangles of the last upper molar may all be quite closed and the same may be true of the first lower molar. The number of mammae is four, both pairs abdominal as in other members of the genus, a fact probably correlated with few young at a birth.

Two species, each with a subspecies, are known, an eastern paler and shorter-tailed, and a western darker and long-tailed, as in the following key:

KEY TO THE CHINESE FORMS OF THE SUBGENUS *Caryomys*

- A. Tail less than half the length of head and body, about 40 mm.
 - a. Color paler, a uniform dull ochraceous buff. *Eothenomys inez inez*
 - b. Color darker, brownish ochraceous to ruddy. *E. inez nux*
- B. Tail exceeding half the length of head and body.
 - a. Color brighter, reddish or ruddy brown ticked with ochraceous. *E. eva eva*
 - b. Color much darker, blackish brown. *E. eva alcinous*

362. *Eothenomys inez inez* (Thomas)

Microtus (Eothenomys) inez Thomas, Abstract Proc. Zool. Soc. London, December 15, 1908, p. 45; Proc. Zool. Soc. London, for 1908, p. 976, 1909.

Microtus (Caryomys) inez Thomas, Proc. Zool. Soc. London, 1911, p. 176.

Caryomys inez Hinton, Ann. Mag. Nat. Hist., ser. 9, vol. 11, p. 162, 1923.

Evothomys rufocanus shanseius Hinton, Monogr. of Voles and Lemmings, vol. 1, p. 251, 1926 (not *E. shanseius* Thomas).

Microtus (Caryomys) inez inez A. B. Howell, Proc. U. S. Nat. Mus., vol. 75, art. 1, p. 51, 1929.

Microtus inez jeholicus Kuroda, Bull. Biogeogr. Soc. Japan, Tokyo, vol. 9, no. 1, p. 17, January 31, 1939. Mt. Mulei, Nekka Province, Jehol.

Type specimen:—A female, adult, skin and skull, No. 9.1.1.188, British Museum, from the mountains twelve miles north of Kolanchow, Shansi, China. Collected May 28, 1908, by Malcolm P. Anderson.

Description:—In this species the tail is less than half the length of head and body, and the fur is fine and silky without strongly projecting hairs as in some of the burrowing microtines. The dorsal surface is very uniform in tint, a clear dull ochraceous buff somewhat mixed with brown-tipped hairs. The lower side is whitish with a pale-buffy wash. The tail, in contrast to the usual condition in *Microtus*, is thinly haired, so that the scaling shows through on minute examination.

The skull is delicately built, with narrow incisors. The third upper molar has the posterior portion or heel relatively longer than in *E. eva*, and though usually with but three outer salients, sometimes shows a fourth as a minute projecting point. This is true of two out of ten specimens examined. In these same skulls the three triangular sections are completely closed, although usually they are more or less confluent.

While *Microtus inez jeholicus*, recently named by Kuroda from Jehol, may prove to be a recognizable race, the only diagnostic point in the description is possibly the longer foot, 17-21 mm., against 16, but the describer does not say whether or not this measurement includes the claw. In the measurements of the original series of *E. i. inez* the claw is omitted, which may explain the discrepancy. I have therefore provisionally regarded *M. i. jeholicus* as a synonym.

Measurements:—The following field measurements, as entered on the labels by the collector, are taken from the original series and are very uniform, perhaps indicating that most of the series, taken in spring of the year, had attained their growth, and were born at least as early as the preceding autumn. All are from Kolanchow, Shansi.

No.	Head and body	Tail	Hind foot (s. u.)	Ear
9.1.1.181 BM	87	33	16.0	10.0
9.1.1.182 BM	88	32	15.5	10.0
9.1.1.183 BM	89	33	16.0	10.5
9.1.1.184 BM	92	32	16.0	10.5
9.1.1.187 BM	90	32	15.5	10.0
9.1.1.188 BM (type)	90	35	15.5	11.0
9.1.1.189 BM	90	33	15.5	11.0
9.1.1.190 BM	90	37	16.0	12.0
9.1.1.193 BM	88	35	16.0	10.0
9.1.1.194 BM	90	32	16.0	10.0

CRANIAL MEASUREMENTS OF *EOTHENOMYS INEZ*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
<i>E. inez inez</i>									
9.1.1.181 BM	23.1	21.8	12.0	13.9	11.7	4.7	5.5	5.5	Shansi
9.1.1.182 BM	23.0	21.5	11.7	14.2	12.0	4.9	5.7	5.4	Shansi
9.1.1.183 BM	23.2	21.7	11.7	13.9	12.1	4.8	5.8	5.4	Shansi
9.1.1.184 BM	23.7	22.1	11.8	14.4	12.5	4.9	5.6	5.8	Shansi
9.1.1.188 BM (type)	23.7	21.5	11.7	14.5	12.4	4.8	5.8	5.6	Shansi
9.1.1.189 BM	23.7	22.4	12.0	14.7	12.5	5.1	5.5	5.5	Shansi
9.1.1.192 BM	23.4	22.0	12.0	14.2	12.5	5.0	5.7	5.7	Shansi
9.1.1.193 BM	23.3	21.7	11.8	14.1	12.0	5.1	5.9	5.8	Shansi
9.1.1.194 BM	22.2	20.8	11.4	13.7	11.7	4.7	5.6	5.7	Shansi
9.1.1.195 BM	23.7	21.5	11.8	13.8	11.5	4.8	5.7	5.4	Shansi
<i>E. inez nux</i>									
10.5.2.75 BM	23.7	21.6	11.5	13.8	11.5	4.9	5.5	5.7	Shensi
10.5.2.79 BM (type)	23.8	21.6	12.2	14.1	11.9	4.8	5.5	5.5	Shensi
10.5.2.81 BM	23.8	22.0	12.0	13.7	11.5	4.7	5.2	5.7	Shensi
10.5.2.82 BM	23.6	21.3	11.6	13.8	12.1	4.8	5.8	5.8	Shensi
10.5.2.85 BM	23.7	21.5	11.7	13.9	11.5	4.8	5.5	5.7	Shensi
10.5.2.87 BM	23.0	21.0	11.3	13.3	11.4	4.8	5.2	5.1	Shensi

Occurrence and Habits:—This, the first of the *Caryomys* group to be described, has all the appearance of a species with more or less fossorial habits. It is characterized by its relatively small ears and the even, silky texture of the fur without conspicuously projecting coarser hairs, while the tail is relatively short, about one-third of the length of head and body. Probably it will eventually be found to inhabit much of the semi-arid country of northern Shansi and Shensi and adjacent regions of similar nature, but at present it is known from the original series taken by Anderson at a locality in the mountains twelve miles northwest of Kolanchow in northern Shansi, and from one recorded by A. B. Howell (1929) in the U. S. National Museum, taken at Yenanku in northern Shensi. Kuroda's "*Microtus inez jeholicus*" from Nekka Province (Jehol), if it is the same, extends the range considerably to the eastward. Nothing is recorded of its habits beyond the brief comment of Anderson that he and A. de C. Sowerby found it "rather common in the bottoms of certain narrow, wooded and bushy gullies" at the first locality. Here it was taken in company with *Apodemus peninsulae*, burrowing in the loose, soft soil beneath the bushes. It may be therefore that it is largely confined to the loess area of this part of China. On account of its even, bright buffy color, Anderson at first took it to be a "red-back." He notes on the label of one of his specimens, an adult female, that on June 4 it held two large embryos and that one or two others of the late May to early June series appeared to be lactating. The small

number of young correlated with the reduced number of mammae (four) is interesting, and may imply that the life habits of the species render it relatively immune against enemies, or, conversely, may account for its apparent scarcity in most of the area where collecting has been done. A partly grown young one with head and body 63 mm. long was taken June 4.

Specimens examined:—Fifteen, the original series, including type, from northwest of Kolanchow, Shansi (B.M.).

363. *Eothenomys inez nux* (Thomas)

Microtus nux Thomas, Abstract Proc. Zool. Soc. London, April 26, 1910, p. 26.

Microtus (Eothenomys) nux Thomas, Proc. Zool. Soc. London, 1910, p. 636.

Microtus (Caryomys) nux Thomas, *ibid.*, 1911, pp. 176, 691.

Evolomys rufocanus shanseius Hinton, Monogr. of Voles and Lemmings, vol. 1, p. 251, 1926 (not of Thomas).

Microtus (Caryomys) inez nux A. B. Howell, Proc. U. S. Nat. Mus., vol. 75, art. 1, p. 51, 1929.

Type specimen:—An adult male, skin and skull, No. 10.5.2.79, British Museum, from the Shangchow district, southeastern Shensi, China.

Description:—In size and proportions this species is quite like typical *E. inez* but differs in being of a much darker color, a deep brownish ochraceous to ruddy, almost as dark as a dull red-backed mouse. Below, the hairs are prominently slaty-based, the tips pale, a warm buff over the chest and belly. Feet covered with short, dull-whitish hairs; tail bicolor, blackish to pale brown above, pale beneath. Ears small, projecting only slightly above the fur, lined with blackish and buff, and having a small concealed tuft of black at the anterior base. One or two of the original series in the British Museum are richer in color than the average, being nearly clear chestnut over the rump and back, shading into ochraceous on the sides of the head and body. The tail, with its short sparse hair hardly covering the scales, and the smaller ear at once distinguish these mice, however, from red-backed mice (*Clethrionomys*). In general the darker hairs of the dorsal surface are seen on close inspection to be mostly tipped with brown, not black.

The skull is quite as in typical *E. inez*, with the posterior lobe of the upper third molar longer than in *E. eva*, with sometimes, as in the type, a small additional projecting angle of enamel making a fourth outer salient. In one specimen (No. 10.5.2.85, British Museum) the tip of the anterior trefoil of the first lower molar is bent around inward, making thus six inner salients instead of the usual five. The outer salient angles of this tooth are normally five.

Measurements:—The following external measurements are from the labels of the original series, as entered by the collector:

No.	Head and body	Tail	Hind foot (s. u.)	Ear	Locality
10.5.2.73 BM	90	37	15.0	11.5	Shensi
10.5.2.76 BM	92	40	16.5	11.0	Shensi
10.5.2.77 BM	89	40	16.0	10.0	Shensi
10.5.2.78 BM	94	37	16.0	11.0	Shensi
10.5.2.79 BM (type)	93	39	16.5	10.0	Shensi
10.5.2.81 BM	93	42	16.5	10.5	Shensi
10.5.2.82 BM	91	37	16.5	11.0	Shensi
10.5.2.83 BM	92	38	16.0	11.5	Shensi
10.5.2.85 BM	91	39	15.5	10.0	Shensi
10.5.2.88 BM	92	38	16.0	11.0	Shensi

For cranial measurements, see table under the typical race.

Occurrence and Habits.—As rightly indicated by A. B. Howell (1929), this is merely a darker race of *E. inez*, its color doubtless to be correlated with the more moist conditions under which it is found in extreme southern Shensi along the foothills of the Tsingling Range. No other examples beyond those originally reported by Thomas appear to have been taken. Three of this series are in the U. S. National Museum. All are from the region about Shangchow, two from Lonanhsien.

Specimens examined.—The following sixteen:

Shensi: Shangchow district, 14, including the type (B.M.); Lonanhsien, 2 (B.M.).

364. *Eothenomys eva eva* (Thomas)

Microtus (*Caryomys*) *eva* Thomas, Abstract Proc. Zool. Soc. London, February 14, 1911, p. 4; Proc. Zool. Soc. London, 1911, p. 175.

Craseomys aquilus G. M. Allen, Mem. Mus. Comp. Zool., vol. 40, p. 216, 1912. Showlungtan, Hupeh.

Evothomys rufocanus shanseius Hinton, Monogr. of Voles and Lemmings, vol. 1, p. 251, 1926 (not of Thomas).

Type specimen.—A male adult, skin and skull, No. 11.2.1.223, British Museum, from southeast of Taochow, Kansu, China, altitude 1,000 feet in mountains. Collected April 3, 1910, by Malcolm P. Anderson.

Description.—This is a dark-colored, long-tailed species, in color much like the typical *Eothenomys* species above, of a reddish or ruddy brown, minutely ticked with ochraceous and black. Lower surfaces gray, the hairs slaty-based and white-tipped; tail indistinctly bicolor, feet whitish. Ears relatively much smaller than in *Clethrionomys*, black-lined or of a mixed black and ochraceous. Adults still in winter pelage (early April) tend to a brighter, slightly redder coloration, while September specimens are duller and browner.

The skull is small and delicate with narrow incisors. The enamel pattern is much as in *E. inez* except that the posterior lobe of the last upper molar is

shorter. The first upper molar has the usual transverse space followed by four alternating closed triangles. The second upper molar consists of the transverse space, then an outer, an inner and an outer closed space, the last more rounded than the others, often with a minute indication of an angle on its inner edge. The last upper molar has a transverse space, then an outer and an inner triangle confluent medially by their bases, followed by a Y-shaped lobe, the inner arm of which forms a projection on the inner side of the tooth so that there are three salient angles and two reëntrants on each side. The first lower molar has a posterior transverse space, in front of which are four alternating closed triangles, then a fifth triangle on the inner side which is minutely open to the small anterior trefoil, making thus four outer angles and three reëntrants and five inner angles with four reëntrants. The second lower molar has the usual posterior transverse space, in front of which come an inner and an outer closed triangle, then an inner and an outer triangle which are confluent by their bases, the latter one the smaller. Young examples may have the triangles of the third upper molar closed, and the first lower molar may have the fifth triangle, counting from the rear, either wholly or nearly closed.

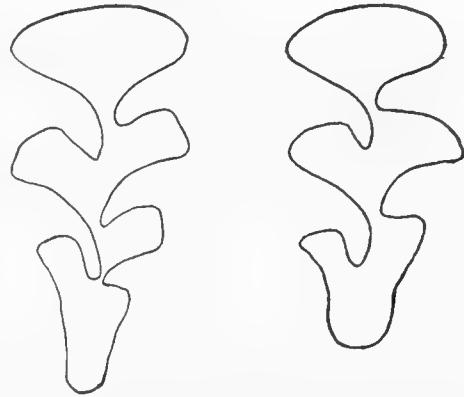


FIG. 36. Approximate outlines of last upper molar in *Eothenomys inez nux* (left), type, No. 10.5.2.79, British Museum; and *E. eva eva* (right), type, No. 11.2.1.223, British Museum. Much enlarged.

Measurements.—The following measurements made in the field by the collectors are in part from the labels of the original series:

No.	Head and body	Tail	Hind foot (s. u.)	Ear	Locality
11.2.1.223 BM	88	50	16.5	12	Kansu
11.2.1.224 BM	89	49	16.5	13	Kansu
11.2.1.225 BM	84	51	16.0	12	Kansu
11.2.1.226 BM	88	50	16.0	12	Kansu
12.8.5.50 BM	86	47	15.0	12	Kansu
12.8.5.51 BM	86	48	16.0	13	Kansu
12.8.5.52 BM	84	46	16.0	11	Kansu
12.8.5.53 BM	92	50	16.0	11	Kansu
11.6.1.55 BM	83	60	16.0	12	Shensi
56380	100	57	18.0	13	Shensi
7189 MCZ (type of <i>C. aquilus</i>)	95	57	17.0	—	Hupeh
7191 MCZ	89	55	18.0	—	Hupeh

CRANIAL MEASUREMENTS OF *EOTHENOMYS EVA*

No.	Greatest length	Basal length	Palatal length	Zygomastic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
<i>E. eva eva</i>									
11.2.1.223 BM (type)	23.4	21.5	11.5	13.2	11.4	4.6	5.4	5.0	Kansu
12.8.5.52 BM	22.0	19.9	11.0	12.6	10.9	4.5	4.7	4.7	Kansu
12.8.5.49 BM	21.6	19.2	10.6	12.0	10.7	4.3	4.9	4.6	Kansu
13.9.13.16 BM	23.8	22.1	12.0	13.3	—	4.7	5.5	5.2	Hupeh
11.6.1.55 BM	23.0	21.0	11.7	13.0	11.5	4.5	5.4	5.1	Shensi
84247	22.4	20.0	11.0	12.4	11.2	4.8	5.0	4.9	Kansu
7189 MCZ	23.5	21.5	11.9	13.6	11.5	4.7	5.6	5.9	Hupeh
7190 MCZ	23.8	21.8	12.5	13.7	11.6	4.6	5.5	5.5	Hupeh
7191 MCZ	23.6	21.7	12.1	13.5	11.0	4.7	5.6	5.6	Hupeh
7194 MCZ	23.2	21.0	11.7	13.3	11.0	4.5	5.7	5.0	Hupeh
<i>E. eva alcinous</i>									
11.9.8.133 BM	22.1	20.5	11.3	12.9	10.6	4.8	5.3	5.3	Szechwan
11.9.8.134 BM	22.6	—	11.7	12.9	—	4.8	5.4	5.5	Szechwan
11.9.8.135 BM	22.4	20.7	11.7	12.9	10.7	4.7	5.3	5.2	Szechwan
11.9.8.136 BM (type)	23.8	22.0	12.2	13.7	11.2	4.8	5.8	5.8	Szechwan
11.9.8.138 BM	21.6	20.0	11.1	12.3	10.3	4.6	5.2	5.2	Szechwan

Occurrence and Habits:—In contrast to *E. inez* this is a dark-colored, long-tailed species characteristic of wooded, mountainous country, and may represent the more ancient stock from which the paler, shorter-tailed species of the drier eastern part of China is derived. So far as at present made out, it occurs from the western parts of Hupeh, westward along the Tsingling Range into the forested parts of southern Kansu. The original series came from southeast of Taochow in the latter province at altitudes of about 1,000 feet, and it has been taken also at Choni and Archuen. Dr. R. C. Andrews secured a series of skins from Taipai Shan on the Tsingling Range at an elevation of 10,000 feet, and there is a specimen in the British Museum from that locality. The most eastern record is of specimens taken by W. R. Zappey for the Museum of Comparative Zoölogy in the wooded mountains near Ichang, Hupeh, at Showlungtan, Fanghsien, and Wansan Shan. Here, as elsewhere, it seems to take the place of the red-backed mice, for the two have not apparently been taken in the same localities. Brief notations on the labels of the British Museum series indicate the nature of the surroundings as "mixed wood on mountain slope; deep moss in forest on steep mountain side; bushy mountain side; damp mossy bank in fir wood; mossy cliff in great fir forest; in damp mossy birch forest; mixed wood on mountain." Nothing further is known of its habits.

It now seems clear from a comparison of specimens, that the animal I described in 1912 as *Craseomys aquilus* from Hupeh is quite the same. In western Szechwan the typical race is replaced by the much darker *E. e. alcinous*.

Specimens examined.—The following thirty-seven:

Hupei: Showlungtan, 3, including type of *Craseomys aquilus* (M.C.Z.); Fanghsien, 2 (M.C.Z.); Wansan Shan, 1 (M.C.Z.).

Shensi: Taipai Shan, 10,000 feet, 16 (A.M.N.H.), 1 (B.M.).

Kansu: southeast of Taochow, 10, including type (B.M.); Archuen, 1; ten miles south of Choni, 1 (A.M.N.H.), 2 (M.C.Z.).

365. *Eothenomys eva alcinous* (Thomas)

Microtus (Caryomys) alcinous Thomas, Abstract Proc. Zool. Soc. London, October 31, 1911, p. 50; Proc. Zool. Soc. London, 1912, p. 140.

Evotomys rufocanus shanseius Hinton, Monogr. of Voles and Lemmings, vol. 1, p. 251, 1926 (not *Evotomys shanseius* Thomas).

Type specimen.—A male, skin and skull, No. 11.9.8.136, British Museum, from Weichow, 8,000-12,000 feet altitude, in the Si Ho or Sungpan Ho valley, western Szechwan, China. Collected November 24, 1910, by Malcolm P. Anderson.

Description.—This is a much darker animal than typical *eva*, although it is similar in size and proportions, with a relatively long tail and a light, delicate skull, quite as in that race. In color it is nearly as dark as *E. melanogaster*, but the ears are a trifle smaller and the much longer tail is distinctive. The general color above is dark blackish brown ("bister brown"), minutely ticked with ochraceous, an effect due in part to the predominance of all-black hairs among the particolored ones with ochraceous tips. The short, rounded ears are clothed with minute black hairs on the proëctote and metentote; the feet are dark brown, the tail blackish all around; the belly is slaty, with the tips of the hairs shining, producing a silvered appearance in some lights, while often there is a faint buffy wash across the chest and abdomen.

The skull is not noticeably different from that of the typical race.

Measurements.—The following measurements are from the labels of the type series as taken by the collector:

No.	Head and body	Tail	Hind foot (s. u.)	Ear	Locality
11.9.8.128 BM	84	53	17.0	10.5	Szechwan
11.9.8.129 BM	86	54	17.0	11.0	Szechwan
11.9.8.130 BM	90	53	17.0	11.0	Szechwan
11.9.8.131 BM	85	56	17.0	11.0	Szechwan
11.9.8.132 BM	93	52	16.5	11.0	Szechwan
11.9.8.133 BM	85	48	16.5	12.0	Szechwan
11.9.8.134 BM	86	54	17.0	11.5	Szechwan
11.9.8.135 BM	86	52	17.0	10.5	Szechwan
11.9.8.136 BM (type)	90	56	17.0	11.5	Szechwan
11.9.8.137 BM	87	53	16.5	12.0	Szechwan
11.9.8.138 BM	83	50	16.5	12.0	Szechwan

For cranial measurements, see table under *E. eva eva*.

Occurrence and Habits.—This race is thus far known only from the original series of thirteen specimens obtained by Anderson in the country about Weichow in the narrow valley of the Si Ho or Sungpan Ho in western Szechwan at altitudes of from 8,000-12,000 feet. These specimens are remarkably dark in color, having the appearance of a long-tailed *E. melanogaster*. If it occurs much farther to the south, it is strange that it should not have been taken by the various expeditions that have collected in western Yunnan and Szechwan.

Specimens examined.—Eleven, including the type, from Weichow, western Szechwan (B.M.).

Genus *Alticola* Blanford

Alticola Blanford, Journ. Asiatic Soc. Bengal, vol. 50, pt. 2, p. 89, 1884. Miller, North Amer. Fauna, no. 12, p. 52, 1896 (as a subgenus). Hinton, Monogr. of Voles and Lemmings, vol. 1, p. 300, 1926 (as a genus). Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 9, p. 400, 1912 (as a genus).

The voles to which this genus pertains are regarded by Hinton very properly as close relatives of *Clethrionomys* (or *Evotomys*) and the browner *Eothenomys*. They share with these the structure of the palate which terminates in a square-edged, thin shelf of bone, lacking an upward-sloping bony bridge connecting its median point with the inner borders of the two lateral pits. The interorbital space, likewise, is wide and the brain case itself is broad and flattened. As in *Eothenomys*, there is a tendency toward the development of opposite but confluent triangular prisms on the last two lower molars, giving a more or less bilaterally symmetrical tooth; the enamel folds are less sharply angular than in *Microtus*, but resemble the rounded salients of *Clethrionomys*; the last upper molar is much like that of *Antelionomys* in that the first outer reëntrant angle is very shallow, not extending across to the opposite enamel wall to cut off a small triangle, but the second outer infold is very deep, bridging the space between the two inner reëntrants and thus cutting off an inner triangular space. The heel of the tooth is somewhat Y-shaped with a long stem, its outer branch longer than the inner and sometimes cut off from the latter. In general the teeth have a characteristic elongated appearance, due in part to the deep reëntrants on both sides that make the central tapering parts of the prisms almost stem-like. The bullæ are usually large; the tail is from at least twice the length of the hind foot to less than its length; the mammæ are eight as in *Microtus* and the plantar tubercles six. Regarded by Miller in 1896 as "one of the best characterized groups in the genus *Microtus*," it is now perhaps justifiable to raise it to the rank of a genus, coördinate with *Eothenomys*, of which perhaps it represents a rock-living instead of a woodland modification. Its range is central and eastern Asia in mountainous country.

According to Hinton (1926), the genus may be divided into two subgenera,

the typical *Alticola* and a more specialized subgenus *Platycranius* with a more flattened skull. Only the former is as yet known to occur in Mongolia, and although Hinton lists thirteen species, but one or perhaps two have yet been reported from the area here covered. They are usually distinguished externally by their pale whitish or grayish color and nearly white tails.

The genotype is *Arvicola* (= *Alticola*) *stoliczkanus* Blanford, from Ladak, Tibetan plateau.

The forms recorded for Mongolia may be known by the following key:

KEY TO MONGOLIAN SPECIES OF *Alticola*

- A. Tail (without terminal hairs) noticeably longer than hind foot.
 - a. Color darker, "mouse gray" above..... *A. macrotis macrotis*
 - b. Color paler..... *A. macrotis semicanus*
- B. Tail shorter than hind foot..... *A. nanschanicus*

366. *Alticola macrotis macrotis* (Radde)

Arvicola macrotis Radde, Reisen im Süden von Ost-Sibirien, vol. 1, p. 196, pl. 6, figs. 2, 2a-h, 1862.

Alticola (Alticola) semicanus alleni Argyropulo, Zeitschr. f. Säugetierk., vol. 8, p. 180, 1933. Kentai Mountains, forty kilometers east of Urga, Mongolia.

Type specimens:—Radde based his description on two specimens preserved in spirit, from the eastern Syansk Mountains, above tree level at more than 7,000 feet, eastern Siberia, near the Mongolian border. They were taken in July, 1859, "bei den Graphitwerken des Herrn Alibert." These cotypes are presumably in the Zoological Museum of the Academy of Sciences at Lenin-grad.

Description:—Radde's original account describes the color as mouse-gray above, the pelage full, 13 mm. in length dorsally, with scattered longer black hairs. Most of the dorsal hairs have a narrow mouse-gray terminal ring, or in some this ring may be subterminal with a minute black tip. Sides and belly pure white, rather sharply marked off; lips and angle of mouth white. Feet white above. This corresponds closely with Argyropulo's description of *Alticola semicanus alleni*, which is "neutral gray" to "deep neutral gray" above, considerably darker than in *A. m. semicanus*, with a characteristic clouding due to the dark tips of some of the hairs. Under side pure white, sharply delimited, the hairs with a short basal portion gray. The ochraceous and yellow tones of the sides of the body and on the feet paler than in the latter.

Measurements:—Radde's specimens in alcohol may have been immature, or at least one was, and possibly the tail of the one measured, which he describes as stumpy, had its tip broken. His measurements are: total length, 92 mm.; tail, 15; hind foot, 16.5; ear, 12. Argyropulo gives the dimensions of six specimens of "*alleni*" as from 107-113 mm. in total length; tail, 29-31; hind foot, 20.2-21.6; ear, 15.4-18.

No skull measurements are given by either author, but doubtless these as well as the general characters of the skull are practically as in *Alticola m. semicanus*. In comparison with the latter, Argyropulo describes the skull as having a more attenuate rostral portion and a more compressed brain case.

Nomenclature:—So far as known to me, no one has attempted to re-identify Radde's *Arvicola macrotis* in the light of more modern knowledge of eastern microtines. Hinton, in his "Monograph of the Voles and Lemmings" (1926), does not mention the name. Yet from a study of the description and the rather crude figures of the enamel pattern published by Radde, it is clearly an *Alticola*, and Dr. B. Vinogradov of the Zoological Museum at Leningrad corroborates this view which he had independently reached. Now that Argyropulo (1933a) has named as new a dark northern race of the Gobi *Alticola*, calling it *Alticola semicanus alleni*, it becomes necessary to consider Radde's name here. The type locality of *A. s. alleni* is given as the Kentai Mountains, forty kilometers east of Urga, Mongolia, and hence but a short distance from the east Syansk Mountains whence came *Arvicola macrotis*. The essential characters of the description and figures seem to indicate that both names refer to the same animal, so that I am constrained to place *Alticola s. alleni* in the synonymy of the latter, with my thanks to its author for his intended compliment. Since *Arvicola macrotis* is the oldest name (except *A. roylei* Gray, 1842, a Kashmir species) given to a member of this group, the Gobi animal, *Alticola m. semicanus*, must stand as a subspecies of it.

Occurrence and Habits:—This is evidently a darker northern representative of the *Alticola* found in the Gobi. Beyond the localities given by Radde (east Syansk Mountains) and by Argyropulo (Ulan-Bator-Choto, forty kilometers east of Urga, and Ssangin, the same distance north of that city), no other records are known. Probably, like the Gobi race, it is partial to rocky or mountainous areas, as the altitudes given by these authors would indicate (7,000 and 3,000 feet approximately).

Specimens examined:—None.

367. *Alticola macrotis semicanus* (G. M. Allen)

Microtus (Alticola) worthingtoni semicanus G. M. Allen, Amer. Mus. Novitates, no. 133, p. 6, 1924.
Alticola worthingtoni semicanus Hinton, Monogr. of Voles and Lemmings, vol. 1, pp. 307, 320, 1926.

Type specimen:—An adult male, skin and skull, No. 57805, American Museum of Natural History, from Sainnoin Khan, Mongolia. Collected June 5, 1922, by the Central Asiatic Expeditions.

Description:—Similar to *A. worthingtoni* of the Tien Shan, but with larger skull, longer tooth rows, and with a buff lateral line and a buff wash over the under surface. General color above, a buffy gray slightly darkened with

scattered black hairs. The individual hairs are slaty at base with a broad subterminal band of white which passes into pale buff a very short distance below the minute blackish tip. Sides of nose, front and back of ears nearly "pinkish buff." Entire under parts, including the upper lips, the lower cheeks, sides of neck, as well as the feet, legs, and tail all around buffy white, the hairs on legs and body with dark bases. The mixed gray of the back is sharply defined at the sides of head and body, and the buff is here clearer and brighter, forming an indistinct "pinkish-buff" lateral line. Vibrissæ very long, the longest about 50 mm., some black, some white.

The skull is larger throughout than that of *A. worthingtoni*, but is apparently not very different otherwise. In profile view there is a slight but distinct depression over the orbital region. The rostrum is relatively long, the inter-orbital region broad, with a rounded ridge or swelling on each side, not very clearly marked. The brain case is broad and slightly flattened, without prominent ridges or crests. The last upper molar has the first outer indentation very shallow, not extending across to the opposite enamel wall to cut off an external triangle; the second outer reëntrant is broad and deep, meeting the opposite enamel wall. The two inner reëntrants are both deep and widely excavated at their median extremity. There are thus formed an anterior transverse space notched on its outer, broader edge, then an inner closed triangle, an outer more or less completely closed one, and an elongate terminal loop. The first lower molar consists of a posterior transverse space, with four closed triangles, two inner and two outer alternating. The fifth (inner) space is open anteriorly to the enamel loop forming the front part of the tooth, a loop with a sharp outer angle and a bluntly rounded inner border. The second lower molar is much like that in species of *Eothenomys*, consisting of a posterior transverse space, then in front of that an inner and an outer closed triangle, and anteriorly an inner and an outer triangle widely confluent at their bases; the tooth is therefore nearly symmetrical, with three outer and three inner angles. The last lower molar is nearly the same, though smaller, but the anterior as well as the posterior pair of triangles are confluent at their bases.

Measurements.—The following external measurements were taken by the collector in the field:

No.	Head and body	Tail	Hind foot	Ear	Locality
57788	121	35	23	21	Mongolia
57789	105	24	20	18	Mongolia
57795	105	31	20	16	Mongolia
57798	105	28	20	15	Mongolia
57805 (type)	110	30	19	20	Mongolia
57816	110	35	22	18	Mongolia
57817	116	27	23	19	Mongolia

CRANIAL MEASUREMENTS OF *ALTICOLA MACROTIS SEMICANUS*

No.	Greatest length	Basal length	Palatal length	Zygomastic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
57788	28.6	26.6	15.2	16.5	14.9	5.7	6.7	6.6	Mongolia
57789	28.5	25.8	14.6	15.9	15.2	5.5	5.9	6.6	Mongolia
57795	27.5	25.3	14.2	15.9	14.1	5.5	6.3	6.5	Mongolia
57805 (type)	29.1	—	15.0	16.7	14.4	—	6.7	6.5	Mongolia
57816	28.8	26.6	14.8	16.3	14.8	5.8	6.2	6.2	Mongolia
57817	28.5	26.5	14.8	16.0	14.5	5.7	6.8	6.2	Mongolia
57798	28.7	26.2	14.7	15.1	14.1	5.6	6.4	6.5	Mongolia

Occurrence and Habits.—This seems to be a near relative of *Alticola worthingtoni* of the Tien Shan in central Asia, but larger. It occurs in suitable places probably across the northwestern half at least of the Gobi. Its particular habitat is among rocks and boulders, or where rocky outcrops occur with a supply of grass at hand for food. Dr. Andrews came upon this species at but four localities: Sainnoin Khan, forty miles southwest of Tsetsen Wang, Hurumtu, and Gun Burte. He writes: "This peculiar mouse I caught first high up near the summit of a rocky peak under a large rock, forty miles southwest of Tze Tzen Wang. It makes great quantities of banana-shaped droppings which appear always to be deposited in one spot at the entrance to the hole under the rocks. I got only two here, but at Sain Noin Khan they were abundant in the loose rocks of some precipitous cliffs, both high up and near the base. The piles of droppings are a sure indication of its presence. It has the coney-like habit of dragging bits of grass and flowers into its burrow under the rocks. Its ears and soft fur are very suggestive of *Ochotona*. At Sain Noin Khan I saw them several times in the late afternoon running about among the rocks. They were very fearless, coming within ten or twelve inches of my hand. They appear to be partly diurnal but chiefly nocturnal. Three were caught here on the sides of the grassy, open valley opposite the forest among the rocks on the hillside. There is a considerable rock outcrop here and this species was abundant. It is essentially a rock-living form." A number of young were taken in the first half of June. No doubt, as Hinton has remarked, the somewhat flattened skull of this genus is to be associated with its habit of living among rock crevices.

It is not unlikely that a third species of this genus will eventually be found within the limits of Mongolia, for *A. strelzovi* is known to occur in the Altai Mountains not far from the western boundaries.

Specimens examined.—In all, forty-seven, as follows:

Mongolia: forty miles southwest of Tsetsen Wang, 2; Sainnoin Khan, 27; Hurumtu, 10; Gun Burte, 8.

368. ?*Alticola nanschanicus* (Satunin)

Microtus nanschanicus Satunin, Annuaire Mus. Zool. Acad. Imp. Sci. St. Pétersbourg, vol. 7, p. 575, 1902.

Type specimen.—The type is a skin and skull in the Museum of the Academy of Sciences at Leningrad, a female, from the upper course of the Sharagol-dschin, Nan Shan, northwestern Kansu, China. Collected in August, 1894, by Roborovski and Kozlov.

Description.—Said to resemble *Alticola blanfordi*, but with shorter ears and tail and minor differences in tooth structure. Above, pale brownish gray, washed with rusty, more intense on the middle of the back, head and ears. Lips, sides, and under surface, white, with the gray bases of the hairs showing through. The brown of the back and the white of the sides are sharply defined. Ears with rusty-golden hairs on both inside and outside. Rump and tail white, the latter with only a touch of yellow at the end. Feet and claws white. Six tubercles on the sole of the hind foot.

The skull of the type was damaged, but was described as flattened above, with a broad interparietal having an anterior projecting angle. Incisive foramina long, almost reaching the level of the molars. The last upper molar is said to resemble that of *A. blanfordi*, but with the terminal enamel loop shorter, forming a small triangle with a blunt end. A small but obvious outer projection was present on the right- but not on the left-hand tooth.

Measurements.—No dimensions were taken in the flesh. Cranial dimensions are: greatest length, 26 mm.; zygomatic width, 15; mastoid width, 13; upper and lower cheek teeth both measure 6. The dimensions of the dried skin are: head and body, 114 mm.; tail, 17 without terminal hairs; hind foot, 19.5.

Occurrence and Habits.—This supposed species was very briefly described by Satunin from a single specimen procured on the upper course of the Sharagol-dschin, Nan Shan. Its general appearance is said to be like that of *Microtus blanfordi*, which is an *Alticola*. But *M. blanfordi* is a much longer-tailed animal than the present, which has a tail shorter than the hind foot, and white. Until further specimens can be secured, the status of this species must be considered as very unsatisfactorily determined.

Specimens examined.—None.

Genus *Microtus* Schrank

Microtus Schrank, Fauna Boica, vol. 1, pt. 1, p. 72, 1798.

This genus includes the typical meadow-mouse group, characterized by the more or less shaggy brown fur, with little or no modification for sub-

terrestrial or aquatic life. The tail is little shortened in most of the species, but may vary from one to three-and-a-half times the length of the hind foot. The ears, though short, project from the fur; the mammae are eight, two pairs pectoral, two abdominal; and the plantar pads are in most species six, though sometimes reduced to five. Whereas in 1896 Miller divided the genus into eleven subgenera, at the present time the tendency is to regard these all as co-ordinate genera, although it is evident that they are not all of equivalent value. Most of the former subgenera with the type of palate ending in a thin transverse shelf may be eliminated, leaving in the genus those in which there is a median bony bridge sloping upward to the front of the interpterygoid fossa. The first lower molar has usually five closed triangles in the typical subgenus, but in others the anterior one or two may be confluent. The second upper molar generally consists of an anterior transverse prism followed by three closed triangles, but in the *Microtus agrestis* group, which includes species of both Old and New Worlds, there is a definite additional postero-internal lobe. Possibly this character alone may be some day regarded as of subgeneric value. The genus is widespread from western Europe eastward to the Pacific, and across North America to the Atlantic Ocean. One species occurs in northern Africa, but elsewhere in the Old World the group is mainly northern, and is represented by various species, some distinguished as special subgenera, the characters of which are partly given in the key on page 847.

The type is the common *Mus* (= *Microtus*) *arvalis* Pallas of Europe.

Subgenus *Microtus* Schrank

Microtus Schrank, Fauna Boica, vol. 1, pt. 1, p. 72, 1798. Miller, North Amer. Fauna, no. 12, p. 62, 1896. *Alexandromys* Ognev, Dnev. Zool. otd. Obsc. Liub., Moscow, vol. 11, p. 109, 1914.

The typical subgenus *Microtus* includes a number of species having a rather wide range of variation in the enamel pattern. In general, however, they all have the "normal" type of palate which terminates in a median ridge sloping slightly dorsally to form a bridge connecting the palate with the sides of the lateral pits, instead of being a transverse shelf with the lateral pits extending forward beneath it. The last upper molar consists usually of a transverse prism of enamel, succeeded by a small outer and a larger inner triangle, then a slightly smaller outer triangle, all of which are normally closed. The heel of the tooth consists of a C-shaped lobe with the upper free end forming a longer inner projection than the lower. The first lower molar consists of a posterior closed transverse prism, in front of which are three inner and two outer triangles, usually completely closed, and an anterior trefoil of variable outline, but in most species with a strong inner projection and a less-developed outer one, making five inner and four outer salients. The second lower molar

has a posterior transverse loop and two inner and two outer alternating triangles, all of which are normally closed. The last molar consists of the usual three transverse prisms, the anteriormost with a slight pointed projection on the outer side. The hind foot has usually six pads, four under the toes and two arranged one behind the other on the tarsus. The fur shows no modification for subterranean or aquatic life, but is usually rather long and shaggy. No lateral scent glands are indicated by external patches of differently shaded fur, such as occur in the subgenus *Arvicola*. Apparently *Alexandromys*, a subgenus proposed by Ognev for *Microtus pelliceus*, must be regarded as a synonym. This species, although large, seems to offer no important characters not found in typical *Microtus*; indeed it is hardly more than a subspecies of *M. fortis*, which is so far as I can see a member of the same subgenus in spite of its having but five plantar pads.

Several species of this subgenus occur in China and Mongolia, most of them, however, in the latter area. They may be distinguished by the following key.

KEY TO CHINESE AND MONGOLIAN SPECIES OF THE SUBGENUS *Microtus*

- A. Second upper molar with two outer closed triangles and one inner closed triangle behind the anterior transverse space.
 - A'. Second upper molar without a postero-internal angular projection.
 - a. Plantar pads six, size medium, foot with claw less than 22 mm.
 - a'. Last upper molar with three outer and four inner salient angles.
 - a''. First lower molar with five tightly closed triangles in front of the posterior transverse space.
 - 1. Larger, dark brown, with buffy wash on belly, hind foot about 19 mm. *M. mongolicus*
 - 2. Smaller, grayish brown, hind foot 16-17 mm. *M. poljakowi*
 - b''. First lower molar with four closed triangles in front of the posterior transverse space, the fifth or anteriormost confluent with the anterior trefoil.
 - 1. Larger, color a decided buffy. *M. limnophilus*
 - 2. Smaller, color dark brown. *M. ratticeps flaviventris*
 - b'. Last upper molar with four outer and five inner salients. *M. obscurus*
 - b. Plantar pads five, size large, foot with claw 22 mm. or more
 - a'. Lower surface of body washed with buffy, tail long, about 67 mm. *M. fortis fortis*
 - b'. Lower surface of body without a buffy wash, whitish, tail about as in typical race. *M. fortis calamorum*
- B'. Second upper molar with a postero-internal angular projection. *M. clarkei*

KEY TO CHINESE AND MONGOLIAN SPECIES OF THE SUBGENUS *Microtus* (Cont'd)

- B. Second upper molar with a closed triangle and an additional small posterior lobe on the inner side.
- a. First lower molar with five closed triangles in front of the posterior transverse space. *M. agrestis mongol*
 - b. First lower molar with four closed triangles in front of the posterior transverse space. *M. millicens*

369. *Microtus mongolicus* (Radde)

Arvicola mongolicus Radde, Reisen im Süden von Ost-Sibirien, vol. 1, p. 194, pl. 7, figs. 1-1c, 1862.

Microtus mongolicus G. M. Allen, Amer. Mus. Novitates, no. 133, p. 10, 1924. Vinogradov and Obolenski, Journ. Mammalogy, vol. 8, p. 235, 1927.

Type specimen:—Although no particular specimen is mentioned in the original description as the type of this species, Vinogradov and Obolenski (1927, p. 235) state that they examined "the unique original specimen of Radde, preserved very unsatisfactorily," presumably at the Museum of the Academy of Sciences at Leningrad. It came "aus den daurischen Hochsteppen, von dem Umgegenden des Tarei-Nor," or extreme northern Mongolia near Tarei Lake.

Description:—A medium-sized species, with rather dark, coarse pelage conspicuously washed with ochraceous, which extends to the sides of the cheeks and the end of the nose, and faintly over the lower surface. This tint is sufficiently bright to give a general "raw umber" appearance to the upper surface. A minute inspection shows that the pelage consists of abundant dark-based hairs whose tips are broadly ochraceous, while mixed with these are many all-black hairs. The wrists and backs of the hands are rather silvery, but the hind feet dark brown mixed with silvery hairs. The tail is indistinctly bicolor, dark brown above shading into pale whitish below. The entire under surface is clothed with bluish-gray hair, the tips of which are whitish but do not conceal the underlying gray, while a faint wash of buffy is usually present across the chest and belly.

The skull in old animals becomes slightly ridged, with a median knife-edged crest in the interorbital region meeting the angular parietal ridges which are low and hardly traceable beyond the middle of the parietals. The zygomatics, while strong, do not bow outward conspicuously, but are nearly parallel-sided; the brain case is oval with inconspicuous squamosal ledges and well-developed lambdoid crests. The incisive foramina are long and very narrow. The palate is normal and the auditory bulla has its wall strengthened by a thick layer of spongy tissue. The tooth pattern, as noted by Vinogradov and Obolenski (1927), is much like that of *Microtus arvalis*, with the second upper molar provided with three outer and two inner angles, the third molar with two small outer triangles and one larger inner triangle, quite closed, and a terminal

C-shaped loop, making in all four inner and three outer angles. The first lower molar has the usual posterior transverse prism with five closed triangles in front of it, two outer and three inner, and an anterior trefoil, making in all four outer and five inner salient angles. In *M. arvalis*, as Vinogradov and Obolenski point out, there is an extra antero-external projection. The second lower molar has as usual a posterior transverse loop and four closed triangles, while the third lower molar has three transverse loops.

Measurements:—In general proportions this species is about like the common meadow mice of the *M. arvalis* group, with tail a little more than a third the length of head and body. The following dimensions are from fresh specimens:

No.	Head and body	Tail	Hind foot	Ear	Locality
45925	132	38	19.0	13.0	Mongolia
22314 MCZ	102	35	15.5	10.5	Siberia

CRANIAL MEASUREMENTS OF *MICROTUS MONGOLICUS*

No.	Greatest length	Basal length	Palatal length	Zygomastic width	Mastoid width	Width outside molars	Upper cheek teeth	Lower cheek teeth	Locality
45925	28.5	27.0	16.0	15.8	11.8	5.2	6.5	6.5	Mongolia
45988	26.6	25.0	14.6	15.3	12.5	5.0	6.0	5.9	Mongolia
46004	29.3	27.7	16.3	16.5	12.9	5.7	6.9	6.7	Mongolia
46010	27.8	26.1	15.1	16.0	12.6	5.4	6.3	6.0	Mongolia
46020	29.1	27.5	(15.8)	16.0	12.7	5.3	6.7	6.5	Mongolia
46091	26.0	24.3	14.6	13.7	12.0	5.1	5.9	6.0	Mongolia

Occurrence and Habits:—This large meadow mouse is apparently common in only the northern part of Mongolia northward into the Transbaikalian region and southern Siberia. It was found in numbers by Dr. Andrews and his party at distances fifteen miles north, and thirty-five and forty-five miles northeast of Urga, and is thus one of the group of northern mammals, including red-backed mice, Eversmann's ground squirrel, and others, whose southern limits are coincident with the southward extension of the open forest and grassy valleys. Vinogradov and Obolenski write that in southern Transbaikalia it inhabits the more fertile meadows or valleys and to some extent the forest regions, especially "valleys covered with *Betula fruticosa*." Radde, who secured the original specimen, found it in the high steppe country about Tarei Nor near the northern border of Mongolia. Its close relationship to *Microtus arvalis* is rather evident, but it does not yet seem clear that it is to be regarded as a race of that species.

Specimens examined:—In all, one hundred and forty-one, as follows:

Mongolia: fifteen miles north of Urga, 17; thirty-five miles northeast of Urga, 3; forty-five miles northeast of Urga, 121.

370. *Microtus poljakowi* Kastschenko

SMALL-FOOTED VOLE

Microtus (Arvicola) poljakowi Kastschenko, Annuaire Mus. Zool. Acad. Imp. Sci. St. Pétersbourg, vol. 6, p. 195, 1901.

Arvicola gregalis Radde, Reisen im Süden von Ost-Sibirien, vol. 1, p. 191, pl. 7, fig. 7, a-c; pl. 11, fig. 2 (as *Hypudaus gregalis*), 1862.

Microtus poljakowi G. M. Allen, Amer. Mus. Novitates, no. 133, p. 10, 1924.

Type specimen.—The type is a male in alcohol, No. 435, in the Museum of the Academy of Sciences at Leningrad, from the Apple Mountains, Dauria, Transbaikalia. Collected by Gustav Radde in 1856.

Description.—This is a small, dark-colored vole, with a small hind foot (16-17 mm.), rather short tail, and whitish belly. The general color above is a decidedly grayish brown, due to the even admixture of black and buffy-tipped hairs, producing a nearly uniform "pepper-and-salt" effect, which is scarcely paler on the sides, but merges gradually into the color of the lower side. The entire under surface, from lower lips to base of tail, including the under surface of the limbs, is soiled whitish, the hairs gray-based throughout, except on the chin and at the wrists. Sometimes a very faint buffy wash is discernible across the belly. Tail bicolor, dark brown to blackish brown above and whitish below. Backs of the feet brownish, changing to silvery in certain lights.

The skull is small and rather smooth, without prominent ridges, the inter-orbital space broad, with a faintly marked median crest in fully adult animals. The rostrum is slender, the zygomata very little bowed. The palate is quite normal, of the *M. arvalis* type, as are also the molar teeth which resemble in enamel pattern those of that animal. The last upper molar has the usual transverse space, followed by two outer triangles alternating with the single inner triangle, then a terminal C-shaped loop. The first lower molar has five tightly closed enamel triangles in front of the posterior transverse prism, and an anterior trefoil, the inner posterior lobe of which is a sharp angle like those behind it, but the outer lobe corresponding is short and rounded. Counting the latter, there are four external projections and five sharp internal angles. The other teeth are as usual in the subgenus.

Measurements.—This mouse is distinguished by its rather small size, with hind foot, including claws, about 17 mm., and the tail slightly less than double this length. Kastschenko gives the following measurements of the type and a second specimen: head and body, 88 (type), 89 mm.; tail, 24.5, 31; hind foot without claws, 15, 14. An adult measured in the flesh by Dr. R. C. Andrews is larger: head and body, 119 mm.; tail, 28; hind foot with claws, 17; ear, 14.

CRANIAL MEASUREMENTS OF *MICROTUS POLJAKOWI*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width outside molars	Upper tooth row	Lower tooth row	Locality
45844	24.6	23.3	13.5	14.3	11.5	4.8	5.9	5.7	Mongolia
45927	24.0	22.7	13.2	13.4	11.0	4.4	5.3	5.3	Mongolia
45954	22.8	21.5	—	12.8	10.4	4.3	5.0	4.8	Mongolia
45995	24.4	22.9	13.1	13.5	11.0	4.8	5.7	5.7	Mongolia
46191	23.5	21.9	13.0	12.5	10.5	4.4	5.0	5.4	Mongolia
46195	22.1	20.5	12.0	12.0	10.5	4.2	5.0	4.9	Mongolia

Occurrence and Habits:—This is a dark-colored vole distinguished by its small size, short hind foot (about 17 mm.), rather short tail, about twice the length of the hind foot, and by its decidedly grayish-brown coat with very little admixture of rufous. It seems to have first been made known by G. Radde, who described and figured it under the name of *Arvicola gregalis* from specimens taken in the Apple Mountains and the Onon valley on the borders of Mongolia and Transbaikalia. He adds that the Mongols dig open the burrows for the stores of bulbs of *Lilium tenuifolium* laid up by these mice. Kastschenko (1901) examined a specimen collected by Radde in the Apple Mountains and found that it did not represent *M. gregalis*, which is a member of the subgenus *Stenocranius*. He therefore named the animal *M. poljakowi*, taking as type the specimen above mentioned. Its range extends from southern Transbaikalia southward well into the northern edge of Mongolia north of the actual Gobi. Dr. Andrews's party found it first some fifteen miles north of Urga, and again at forty-five miles northeast and forty miles southwest of the same center. It was not encountered to the south or westward.

Vinogradov and Obolenski (1927), who have examined Radde's material in the Museum of the Academy of Sciences at Leningrad, incline to make this a synonym of *M. mongolicus*, with which it agrees in the essential structure of the enamel pattern. If, however, my identification of the large brown vole of this same region as *M. mongolicus* is correct, the smaller animal is a quite distinct species, agreeing in the characters of small foot, short tail, dark color, and cranial size with Kastschenko's description, so that I think the latter's name must be regarded as valid for it.

Specimens examined:—In all, forty-four, as follows:

Mongolia: fifteen miles north of Urga, 19; forty-five miles northeast of Urga, 22; forty miles southwest of Urga, 3.

371. *Microtus limnophilus* Buechner

Microtus limnophilus Buechner, Wiss. Resultate d. v. Przewalski Reisen, vol. 1, Säugethiere, p. 110, 1889; pl. 17, fig. 4, pl. 18, figs. 11-13, 1890.

Type specimens:—Buechner described this vole on the basis of five speci-

mens, all of which are cotypes, from Tsaidam, of which three are from Ganssy, Nos. 1909, 2334, 2335, Museum of the Academy of Sciences at Leningrad, and two are from Ssyrtyn, Nos. 2248, 2249. These were collected by Przewalski in the course of his expeditions of 1879 and 1884.

Description.—This is a very yellowish vole above, the long hairs of the back having their basal two-thirds slaty, and the terminal third pale buff, giving a general “buff” effect which is only slightly darkened by the intermixture of long, all-black hairs. Backs of the fore feet silvery, of the hind feet somewhat more buff, through which the pigmented skin shows slightly. Under surfaces from lips to base of tail and including the inner side of arms and legs clothed with gray-based hairs having dull-whitish tips, giving a bluish-gray effect. Tail bicolor, buffy brown like the back above, whitish below.

The number of mammæ, which Buechner states was unknown to him, proves to be eight, as usual in the subgenus, namely, two pairs pectoral, two pairs abdominal.

The skull has the profile of the rostrum rather sharply depressed, the inter-orbital region in adults narrowed and with a median ridge; the palate is strictly “normal,” with narrow incisive foramina continued backward as shallow grooves the length of the palate. The upper molars are of the usual *M. arvalis* pattern, the anteriormost consisting of a transverse prism followed by two outer and two inner closed and alternating triangles, making three projections on each side; the second upper molar has two outer closed triangles and one inner closed triangle behind the transverse prism, making three outer and two inner projections; the third upper molar has an anterior transverse prism, then an outer, an inner, and a second outer closed triangle, and a terminal C-shaped space with its free ends on the inner side, making four inner and three outer projecting angles. The characteristic dental feature comes in the first lower molar which has the usual posterior transverse enamel prism, in front of which are two outer and two inner alternating closed triangles, while the fifth triangle (on the inner side), instead of being closed, is narrowly open into the terminal loop, which itself has a well-developed angular projection on the inner side but a very faint outer one with rounded border. The tip of the trefoil tends to curve about to the inner side of the tooth, so that, counting these two rounded lobes, there are four outer and six inner salients. The second lower molar has two inner and two outer alternating closed triangles in front of the posterior transverse prism. In the last lower molar the two anterior transverse spaces show a slight indenting angle on the posterior border, and the tooth has three outer and three inner salients.

Measurements.—The following dimensions are from fresh specimens as taken by the collector:

No.	Head and body	Tail	Hind foot	Ear	Locality
84221	95	35	20	9	Mongolia
84222	88	34	21	13	Mongolia
84223	115	44	21	14	Mongolia
84225	109	36	21	14	Mongolia
84226	116	43	21	13	Mongolia
84227	118	39	20	13	Mongolia
84228	110	32	20	14	Mongolia

CRANIAL MEASUREMENTS OF *MICROTUS LIMNOPHILUS*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
84225	27.5	25.8	15.9	15.5	12.7	5.5	6.8	6.5	Mongolia
84227	28.1	26.1	16.3	15.9	13.0	5.3	6.8	6.9	Mongolia

Occurrence and Habits.—So far as yet known, this species is characteristic of the salty morasses of the desert, from the western Gobi to at least the type locality in northwestern Tsaidam. The only Mongolian specimens I have seen were taken by Dr. Andrews in 1925, when he secured a small series at Orok Nor and Kholobolchi Nor in western Mongolia. The pale buffy color recalls that of the still paler *M. (Phaiomys) brandtii*, and as in that species may possibly go with diurnal habits.

Specimens examined.—In all, nine, as follows:

Mongolia: Orok Nor, 7; Kholobolchi Nor, 2.

372. *Microtus ratticeps flaviventris* Satunin

Microtus limnophilus flaviventris Satunin, *Annuaire Mus. Zool. Acad. Imp. Sci. St. Pétersbourg*, vol. 7, p. 577, 1902.

Microtus malcolmi Thomas, *Abstract Proc. Zool. Soc. London*, February 14, 1911, p. 5; *Proc. Zool. Soc. London*, 1911, p. 174; *Ann. Mag. Nat. Hist.*, ser. 8, vol. 10, p. 401, 1912. Southeast of Taichow, Kansu.

Type specimen.—A skin with imperfect skull, number not given, male, in the Zoological Museum of the Academy of Sciences, Leningrad, from near the "Tschortentan" Temple, Kansu, China, altitude 7,100 feet. Collected by Kozlov.

Description.—Satunin compares his specimen with *M. limnophilus* with which it shows much agreement in tooth pattern and general proportions, but in color is quite different, a reddish brown above, with the belly pale yellowish brown. The specimens here referred to the same animal are of much the usual meadow-mouse color, a general dark brown, in which the ochraceous element in the particolored hairs is, however, rather pale, near pale ochraceous, much

mixed with black, making a slightly grayer brown than *M. mongolicus*, but nowhere near as pale a buffy as *M. limnophilus*. The belly in summer skins is a general pale bluish gray due to the blue-gray bases of the hairs showing through the narrow white tips. The backs of the feet are dull silvery, and the tail is bicolor, blackish brown above, whitish below. In its general appearance this mouse rather resembles *M. (Neodon) irene*, but the pelage is slightly coarser.

The skull closely resembles that of *M. ratticeps* of Europe, except that it is smaller with shorter tooth rows, so that I have regarded it as a race of that species. The first and second upper molars are of the usual *M. arvalis* type, the first having a transverse prism followed by two inner and two outer alternating closed triangles; the second tooth has two outer closed triangles and one inner closed triangle; the third upper molar has a single transverse prism followed by two small outer triangles and one larger inner triangle between, then a posterior, somewhat C-shaped loop, so that there are three outer and four inner salient angles. The tooth differs from that of *M. ratticeps* of Europe in lacking a minute fourth spur of enamel behind the second outer triangle. The pattern of the first lower molar is quite like that of *M. limnophilus* in that there is a posterior transverse space, in front of which are four closed triangles, two inner and two outer, alternating, while the fifth, inner triangle is open broadly into the anterior crescentic loop. This loop is less of a trefoil than in many *Microti*, with a rounded anterior boundary, a deep notch on the inner side and a shallow one on the outer. The second and third lower molars are as usual in the subgenus.

Measurements.—This is a medium-sized *Microtus*, the type of which is said to have measured: head and body, 123 mm.; tail, 33; hind foot, 19. Probably Satunin's dimensions were taken from the dried skin.

The skull of Satunin's type was broken, so that the length and width dimensions cannot be given exactly, but the upper molar row was 6.2 mm.

The series in the British Museum described by Thomas as *M. malcolmi* affords the following fresh measurements:

No.	Head and body	Tail	Hind foot (s. u.)	Ear	Locality
11.2.1.199 BM (type of <i>M. malcolmi</i>)	103	40	17	13	Kansu
12.8.5.35 BM	112	49	18	16	Shensi
12.8.5.36 BM	111	44	14	13	Shensi
12.8.5.38 BM	104	44	18	13	Shensi
12.8.5.39 BM	106	32	16	12	Kansu
12.8.5.40 BM	110	41	17	13	Kansu
11.11.1.5 BM	100	37	17	12	Kansu

CRANIAL MEASUREMENTS OF *MICROTUS RATTICEPS FLAVIVENTRIS*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
II.2.1.199 BM (type of <i>M. malcolmi</i>)	26.4	24.6	14.3	14.8	12.8	5.1	6.1	6.1	Kansu
II.2.1.200 BM	25.7	24.0	14.2	14.4	12.2	5.5	5.9	5.7	Kansu
II.2.1.201 BM	24.5	22.6	13.4	13.4	12.0	4.8	5.7	5.5	Kansu
II.2.1.203 BM	23.7	—	13.1	13.0	11.9	4.6	5.7	5.6	Kansu
II.2.5.40 BM	26.3	24.7	14.2	14.5	12.6	5.7	6.0	6.1	Kansu
II.2.5.39 BM	25.6	23.8	14.2	13.7	12.2	4.9	6.3	6.3	Kansu
II.2.5.30 BM	26.0	24.3	14.6	14.5	12.5	5.1	5.8	5.7	Shensi
II.2.5.35 BM	26.6	24.8	14.9	14.7	12.7	5.2	5.9	5.6	Shensi
II.11.1.5 BM	25.9	24.3	14.4	14.6	12.6	5.4	6.4	6.0	Kansu

Nomenclature.—This is the vole described by Thomas in 1911 as *Microtus malcolmi* from specimens taken in the mountains southeast of Taochow, Kansu. He compares it with *M. calamorum* and *M. limnophilus*, and at the same time points out the similarity of the first lower molar to that of *M. ratticeps*. But *M. limnophilus* is larger and much more buffy in color, and seems to be a desert-living species of the same group, while the Kansu animal is found in country at least to a large extent forested. The very much browner appearance of the latter is the chief characteristic pointed out by Satunin in describing his *M. l. flaviventris* which is from similarly forested country near the Tschortentan Temple in the same province. It therefore seems almost unquestionable that the two are really the same and that Satunin's name has priority. That this vole is really a representative of *M. ratticeps* of Europe also seems hardly open to doubt, for the two are quite indistinguishable when compared side by side, except that the teeth of the Asiatic race are slightly smaller, and the third upper molar lacks the minute enamel projection on the outer side of the terminal loop behind the second triangle. I have therefore ventured to make this vole a subspecies of *M. ratticeps*, thus emphasizing again its obvious relationships and carrying the range as a species to extreme western China, where it may very likely now be cut off by the intervening dry country from direct communication with the range of its western relative.

Occurrence and Habits.—This is apparently not an uncommon species in the western part of Kansu. Except for the type specimen from Tschortentan, it is known only from the records of Thomas, who in 1911 redescribed it from the mountains southeast of Taochow, as *Microtus malcolmi*. In the following year, however, on the basis of specimens taken by Malcolm P. Anderson and others, Thomas (1912d, p. 401) extended the range eastward forty to forty-six miles south of Taochow, and still farther, at forty-five miles southeast of Fengsiangfu in western Shensi. More recently, collections made in the

vicinity of Archuen and Choni, Kansu, intermediate between those localities, contain several of these interesting mice. Since this is more or less forested country, it is perhaps in part confined to that type of terrain. Habitat notes on the labels of the British Museum series are: dry shrubby bank on mountain side; grass meadow by a stream; mossy ground around rotten fir tree roots; rocky mossy mountain top.

In outward appearance this meadow mouse is strikingly like a large *Neodon* varying in color from a grayish brown to a warm-buffy or ochraceous brown. The tooth characters are of course distinctive, with the anterior lower molar provided with four closed triangles in front of the terminal transverse prism, and the fifth or anteriormost confluent with the anterior trefoil. This is the condition in fourteen of the sixteen specimens in the British Museum, but in the two others the fifth triangle is closed. The outer point of the anterior trefoil is usually obsolete.

Specimens examined.—The following eighteen:

Kansu: mountains southeast of Taochow, 12, including the type of *M. malcolmi* (B.M.);

Archuen, 1 (A.M.N.H.); Choni, 1 (M.C.Z.).

Shensi: Fengsiangfu, 4 (B.M.).

373. *Microtus obscurus* (Eversmann)

Hypudæus obscurus Eversmann, Mém. Sav. Univ. Kazan, vol. 1, p. 156, 1841.

Microtus arvalis var. *obscurus* Trouessart, Cat. Mamm. Viv. Foss., p. 558, 1897.

Microtus obscurus Hollister, Proc. U. S. Nat. Mus., vol. 45, p. 515, 1913. G. M. Allen, Amer. Mus. Novitates, no. 133, p. 10, 1924.

Type specimen.—The original specimen is apparently not known to be in existence. The species was described, however, from the Altai Mountains.

Description.—Externally with the usual meadow-mouse appearance, but a rather light shade of buffy brown, not unlike Ridgway's "tawny olive," above, the result of a mixture of the dark-based hairs with broad, pale-buffy tips and numerous all-black hairs. Backs of the feet drab, mixed with silvery. Tail nearly black above, shading into whitish below, with the terminal hairs fairly long, forming a slight pencil. Entire under surface of body and limbs clothed with hairs that are dark bluish gray at their bases, tipped with clear whitish, but not so as wholly to obscure the under tints, resulting in a grayish or bluish gray and whitish.

The skull in its general shape is a good deal like that of *M. mongolicus*, rather slender, the zygomata strong, but not much bowed outward, the ridges on the parietals and the interorbital region present but low and not very pronounced. The palate is of the typical microtine type, with the usual bony bridge sloping upward from the posterior edge of the palate to the inner edges

of the lateral pits. The incisive foramina are shorter and more open in front than in *M. mongolicus*, but are narrowed behind. The enamel pattern of the molars is distinctive: the first and second upper molars are of the usual *M. arvalis* type, the former with three inner and three outer, the latter with three outer and two inner salient angles. In the third molar, however, the pattern of the posterior loop is more complex than in *M. mongolicus*. There is first a transverse prism, then a small outer closed triangle, a larger inner and a second smaller outer triangle, all closed or essentially so. These are followed by a complex heel consisting of a small external angular projection, then on the inner side an anterior and a posterior narrow loop, slightly convex forward, and a posterior incurved heel, making in all four well-marked external salients and five internal ones.

Measurements.—This vole is of about the same size as *M. mongolicus*. The following dimensions were taken in the flesh:

No.	Head and body	Tail	Hind foot	Ear	Locality
46128	118	35	19	15	Mongolia
57536	117	—	19	14	Mongolia

CRANIAL MEASUREMENTS OF *MICROTUS OBSCURUS*

No.	Greatest length	Basal length	Palatal length	Zygomastic width	Mastoid width	Width outside molars	Upper cheek teeth	Lower cheek teeth	Locality
46114	27.0	25.5	14.5	14.7	12.6	4.9	6.1	5.8	Mongolia
46128	27.5	25.5	15.2	15.2	12.4	5.1	6.2	6.0	Mongolia
46138	29.4	27.7	16.1	16.1	12.9	5.1	6.5	6.1	Mongolia
46175	28.0	26.2	15.2	15.5	13.2	5.2	6.5	6.2	Mongolia
57536	28.6	27.0	15.5	16.0	13.0	5.0	6.0	6.6	Mongolia

Occurrence and Habits.—This is another boreal species of vole, the southern range of which extends to the northern borders of Mongolia. Dr. Andrews secured a large series at the same localities, fifteen miles north and forty-five miles northeast of Urga, where he obtained *M. mongolicus*. In addition to this series he encountered the species again considerably to the southwestward at Sainnoin Khan, some three hundred miles distant. Probably the habitat of *M. mongolicus* is more in grassy areas, while that of *M. obscurus* is forest, as the following notes of Dr. Andrews would indicate. Writing of Sainnoin Khan, 8,000 feet altitude, he says: "I found a large colony where their runways were very plentiful and well marked in the moss. On the north side of the mountain, across the valley, where there are many patches of forest and more moist than the patch in which we are camped, I found this vole abundant. It makes extensive runways through the moss some 20 or 35 feet long. It appears to prefer moist rather than dry ground although it is found in both. I found one colony where there was such an amount of wet moss that the water was

standing in the runways. The animal is diurnal as well as nocturnal for I had them early in the morning in traps set late in the evening. It is entirely forest-living."

Except for the series here recorded, there appears to be no other mention of the species from Mongolia in the literature. Hollister (1913c) reported on specimens obtained by him in Siberia from the Tchegan-Burgazi Pass and the forests near Tapucha in the Altai region, and pointed out the characters of teeth and color that distinguish this from *M. arvalis* to which no doubt it is rather closely related. It is larger, with a much larger skull but actually smaller teeth, and the color is darker and richer.

Specimens examined:—In all, eighty, as follows:

Mongolia: fifteen miles north of Urga, 46; forty-five miles northeast of Urga, 14; Sainnoin Khan, 20.

374. *Microtus fortis fortis* Buechner

REED VOLE

Microtus fortis Buechner, Wiss. Resultate d. v. Przewalski Reisen, p. 99, 1889; pl. 16, figs. 1-2, pl. 18, figs. 1-3, 1890.

Microtus calamorum superus Thomas, Abstract Proc. Zool. Soc. London, May 2, 1911, p. 27; Proc. Zool. Soc. London, 1911, p. 691. Fengsiang, Shensi.

Type specimens:—This species was described from two males, an adult, No. 1535, and an immature, No. 2250, Museum of the Academy of Sciences at Leningrad, from the valley of the north loop of the Hwang Ho, on the border of the Ordos Desert, southern Mongolia. Collected by the Przewalski Expedition in 1871.

Description:—This is a large species with relatively long tail, and of buffy-brown appearance, belonging to a small group with but five plantar pads instead of six. It is described as of a brownish golden-gray above, slightly washed with rusty and heavily lined with blackish, producing an effect much like the color of the Norway Rat, or a general tawny olive, lined with black, slightly clearer, nearly pale ochraceous on the sides, and on the ventral surface whitish with a slight buffy wash. The fur is everywhere dark bluish gray at the base. Backs of the fore feet whitish and brown, of the hind feet more uniform brown or, in some, much mixed with silvery. Tail distinctly bicolor, blackish brown above, whitish below.

The skull is large and vaulted, with in adults a close approximation of the interorbital ridges which diverge squarely behind forming a slight angular ridge following more or less the outer borders of the parietals. The height from the molar surface to the vertex is almost as great as the zygomatic width, and the incisors are slightly thrown forward so as to be visible from above. The tooth

pattern is essentially of the *M. arvalis* type. The first upper molar has the usual transverse prism followed by four alternating closed triangles, making three inner and three outer angles; the second upper molar has the transverse prism and three closed triangles; the third upper molar consists of a transverse space followed by three closed triangles, two small outer triangles and a single larger inner one, then a terminal C-shaped loop, the free ends of which are on the inner side of the row, making four inner and three outer salients. The first lower molar is as in typical *Microtus* with a posterior transverse prism, in front of which are five closed triangles and a trefoil the inner side of which has a sharply angular projection, while the outer side has a rounded lobe, making three inner and two outer angles in addition to the trefoil.

Measurements.—Buechner states that the head and body of the larger male measured 197 mm., but this is quite obviously a mistake for the total length. Making this correction, the dimensions of this specimen and of others available are as follows:

No.	Head and body	Tail	Hind foot	Ear	Locality
1535 Buechner (type)	135	62	26.0 (?c. u.)	—	Mongolia
32276	125	67	22.0	15	Shensi
17856 MCZ	115	48	22.0	15	Shensi
(type of <i>M. c. superus</i>)	130	63	24.0	13	Shensi
11.6.1.41 BM	130	63	25.0	15	Shensi
11.6.1.44 BM	135	64	22.5	14	Shensi
11.6.1.49 BM	124	57	23.0	15	Shensi

CRANIAL MEASUREMENTS OF *MICROTUS FORTIS*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width outside molars	Upper cheek teeth	Lower cheek teeth	Locality
<i>M. fortis fortis</i>									
32276	33.1	31.2	18.7	17.4	13.8	6.0	7.7	7.3	Shensi
17856 MCZ	31.4	29.3	17.7	16.5	14.4	6.2	7.3	7.4	Shensi
18736 MCZ	28.3	26.5	16.3	14.6	12.6	6.0	7.0	7.0	Shensi
1535 Buechner (type)	31.0	—	—	17.0	13.5	—	—	—	Mongolia
11.6.1.45 BM	32.8	30.6	18.6	17.2	14.1	6.3	7.8	8.5	Shensi
11.6.1.46 BM	32.1	29.8	17.6	17.6	13.8	6.0	7.8	7.5	Shensi
11.6.1.52 BM	31.7	30.0	17.8	16.5	13.8	6.5	7.7	7.6	Shensi
<i>M. fortis calamorum</i>									
2.6.21.4 BM	29.5	28.3	16.8	16.7	13.5	6.1	7.0	7.2	Kiangsu
2.6.21.5 BM (type)	29.6	27.8	17.0	—	—	6.0	7.5	7.6	Kiangsu
8.8.11.104 BM	29.7	28.0	17.2	16.5	13.6	5.9	7.4	7.3	Kiangsu
13.12.8.28 BM	26.8	—	15.5	14.5	12.6	5.5	6.7	6.7	Kiangsu

The cranial measurements of the type skull of *M. fortis fortis* are taken from Buechner's natural-size figure.

Nomenclature.—This large *Microtus* and its immediate allies form a small group widespread in eastern Asia from the Ussuri region to southwestern China. The large size and the presence of but five plantar tubercles recall, as Thomas was the first to suggest, the American members of the subgenus *Arvicola*. Should these later be set apart as a group distinct from *M. terrestris* and its allies of the Old World, Rhoads's name *Aulacomys* would probably apply to them. A synonym would be Ognev's *Alexandromys*, proposed as a subgenus, the type of which is *Microtus pelliceus* of Ussuri. To the northwest the group is represented by *M. michnoi*, doubtfully distinct from the latter, which has been recorded by Vinogradov and Obolenski from southern Transbaikalia.

There seems to be no reason to doubt that Thomas's *M. calamorum superus* is a synonym of *M. fortis*, for the descriptions are essentially in agreement, and Fengsiangfu, the type locality in southern Shensi, is in country not very dissimilar to that bordering the Ordos on the same river drainage. I have therefore regarded it as the same.

Occurrence and Habits.—This is a large and rather bright-tawny meadow mouse of a species widespread in eastern Asia, where it seems to frequent the banks of streams mainly and so perhaps is more confined to river beds than some of the other microtines that are dwellers in open grasslands or woods. The two original specimens were secured by Przewalski who found them in numbers making burrows along the margins of the Chuanche in the valley of the northern loop of the Hwang Ho in extreme southern Mongolia. Apparently the range is more or less coextensive with the river drainage, for the series secured by M. P. Anderson and his party were all taken higher up on the same river, some thirty to forty-five miles south of Fengsiang in Shensi, on the north side of the Tsingling Range. The long tail is a rather striking feature of the species, in addition to its rather bright buffy or tawny color.

The species is represented in the lower Yangtze region by a closely allied race, *M. f. calamorum*. There can be little doubt that the species described from the Ussuri region of eastern Siberia is also closely related and should probably stand as a race, *M. f. pelliceus*, while Vinogradov and Obolenski (1927) have indicated that *M. michnoi* of Transbaikalia is likewise at best a subspecies. If the two later prove identical, the latter name proposed by Kastschenko in 1910 has priority. These authors, however, incline at present to regard the two as distinct. The latter species probably occurs in extreme northeastern Mongolia, for the authors mentioned record its presence at Tarei Nor, just over the border in southern Transbaikalia.

Specimens examined:—Thirteen, from forty-five miles south of Fengsiang, Shensi: 6 (A.M.N.H.); 7, including type of *M. malcolmi* (B.M.).

375. *Microtus fortis calamorum* Thomas

YANGTZE VOLE

Microtus calamorum Thomas, Ann. Mag. Nat. Hist., ser. 7, vol. 10, p. 167, 1902.

Microtus calamorum calamorum A. B. Howell, Proc. U. S. Nat. Mus., vol. 75, art. 1, p. 53, 1929.

Type specimen:—A skin and skull, No. 2.6.21.5, British Museum, from the north bank of the lower Yangtze near Nanking, Kiangsu, China. Collected February 28, 1902, by E. B. Howell.

Description:—Similar to the typical race, but the tail slightly shorter, and the skull and nasals possibly averaging shorter. The general coloration does not apparently differ much from that of the more northern form, and is described as a dark brown, "of about the same intensity as in European *M. agrestis*, but more heavily lined. Sides of nose, rump and hips with a slight fulvous suffusion. Under surface whitish, the bases of the hairs slaty. Ears fairly long, not entirely hidden by the fur, dark brown. Hands pale greyish, feet dull brown above. Tail more than twice the length of the hind foot, blackish brown above, white below." The hinder part of the sole is hairy, as in typical *M. fortis*.

The skull is in general much like that of the typical race, large with the profile rather deep, so that the height from the molar surface to the vertex is about equal to the breadth of brain case. Incisors slightly projecting, visible from above. The palatal arch is pointed forward, the lateral pits deep and connecting by pores running forward to the palatal grooves.

Measurements:—Thomas records the following measurements taken from the fresh specimen:

	Head and body	Tail	Hind foot	Ear
Type	127	53	21 (s. u.)	14
Another	139	53	23 (s. u.)	14

For cranial measurements, see table under *M. fortis fortis*.

Occurrence and Habits:—E. B. Howell, who sent the original specimens to the British Museum, wrote that these voles are common about Nanking on both banks of the Yangtze, and are apparently not to be found away from the peaty soil representing the old alluvial deposit of this valley, on which in summer tall reeds grow in profusion often to a height of from twelve to fifteen feet, and are cut in winter. The ground below these reeds is dotted with patches of coarse grass beneath which the mice make their burrows, sometimes covering

an area of fifteen yards square with their holes. Their food, as shown by stomach examination, consists of roots, grasses, and the pith of the reeds. The young are five or six at a birth. A female taken March 12 contained six embryos. At Chinkiang, La Touche found it common also. He noted that during the floods of the summer of 1901 many were floated out of their burrows and invaded the settlement.

Of the series in the collection of the British Museum, specimens taken in March are actively moulting (near Nanking). The under fur is so blackish that when exposed it stands in strong contrast to the buffy over fur. One (March 12) has worn off all the tips of the fur on the occiput, lower back and flanks, where the short black fur presents a curious appearance. Another (March 18) still wears the long winter fur along the sides, but from the occiput to the root of the tail has shed a long median strip of fur, exposing the black under fur, with a few buffy tips where new hairs are coming in. In full pelage this is a decidedly buffy-looking mouse.

Specimens examined:—The following seven:

Chekiang: Dahyang, 1 (M.C.Z.).

Kiangsu: Nanking, 6, including the type (B.M.).

376. *Microtus clarkei* Hinton

CLARKE'S VOLE

Microtus clarkei Hinton, Ann. Mag. Nat. Hist., ser. 9, vol. 11, p. 158, fig. 14, 1923; Monogr. of Voles and Lemmings, vol. 1, p. 67, fig. 41, 1926.

Type specimen:—An adult female, skin and skull, No. 22.12.1.46, British Museum, from the divide between the Kiukiang and Salween Rivers in north latitude 28° and altitude 11,000 feet, Yunnan, China. Collected July 24, 1921, by George Forrest.

Description:—"Essential external characters nearly as in *calamorum*," but size slightly less, the tail, however, long as in typical *M. fortis*. Hinton describes the general color above as in *M. fortis calamorum*, "dark brown (near 'bistre' of Ridgway). Under surface much less white, the ventral hairs having their basal three-fourths deep slate, and only their tips silver. Flank line of demarcation regular, but not sharply defined. Upper surface of tail brownish, not much lighter than the back; its lower surface, together with the upper sides of the hands, and feet, dirty white."

Notwithstanding a certain superficial resemblance to *M. fortis* in its color and long tail, this is apparently a distinct species. The color is less yellowish and is finely peppered with ochraceous or ferruginous tips to the hairs, giving a brighter reddish or warm brown instead of an olive to tawny effect.

The second upper molar is of distinctive form, with a small but well-defined inner posterior angle opposite the third outer salient, so that the tooth has three inner as well as three outer salients. The last upper molar has a transverse space, then the usual small outer and larger inner, and a second small outer triangle followed by a C-shaped heel, making four outer and four inner salient angles. The first lower molar has five closed triangles and an anterior trefoil in front of the posterior transverse loop; the second lower molar has four closed triangles and the posterior space, making three outer and three inner projections. The palate ends in an even arch without median projecting spine. The lateral pits are normal in form but very shallow.

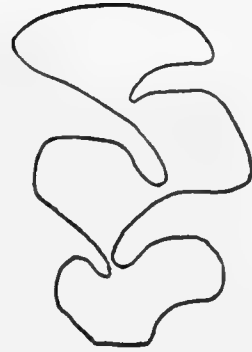


FIG. 37. *Microtus clarkei*, outline of second upper molar (from the type, No. 22.12.1.46, British Museum). Much enlarged.

Measurements.—The following field measurements are from specimens in the British Museum:

No.	Head and body	Tail	Hind foot (s. u.)	Ear	Locality
22.12.1.43 BM	134	67	21	15	Yunnan
22.12.1.44 BM	130	62	21	15	Yunnan
22.12.1.45 BM	125	63	21	13	Yunnan
23.10.11.14 BM	114	66	19	12	Yunnan

CRANIAL MEASUREMENTS OF *MICROTUS CLARKEI*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
22.12.1.43 BM	28.8	—	16.1	17.6	—	6.0	7.0	6.5	Yunnan
22.12.1.44 BM	—	—	15.5	16.6	—	5.7	6.8	6.6	Yunnan
22.12.1.45 BM	27.9	26.6	16.0	16.5	13.7	5.8	6.5	6.5	Yunnan
22.12.1.46 BM (type)	(28.0)	—	16.1	16.5	13.1	5.8	6.5	6.6	Yunnan
23.10.11.14 BM	28.5	26.8	15.8	16.6	12.8	5.7	6.7	6.5	Yunnan

Occurrence and Habits.—The precise relationship of this vole is still uncertain. The few known specimens agree in size and in the possession of a distinct postero-internal cusp on the second upper molar, suggesting the condition in the *M. agrestis* group. Four specimens from the region of the Kiukiang-Salween divide, Yunnan, in 28° north latitude, were captured among rocks or on alpine meadows at altitudes of about 11,000 feet, while a fifth was taken in coniferous forest on the Likiang Range at 13,000 feet. In addition to these, there is an immature specimen in the Museum of Comparative Zoölogy from Mengtsz, southern Yunnan, which seems to be the same, and agrees in the presence of a small inner point at the posterior end of the second upper molar.

Specimens examined.—Six, namely:

Yunnan: Kiukiang-Salween divide, 4, including the type (B.M.); Likiang Range, 1 (B.M.); Mengtsz, 1 (M.C.Z.).

377. *Microtus millicens* Thomas

Microtus millicens Thomas, Abstract Proc. Zool. Soc. London, October 31, 1911, p. 49; Proc. Zool. Soc. London, 1912, p. 138.

Type specimen.—An adult male, skin and skull, No. 11.9.8.105, British Museum, from Weichow, sixty miles northwest of Chengtu in the Si Ho or Sungpan Ho valley, northwestern Szechwan, China, 12,000 feet altitude.

Description.—A grayish *Microtus* with relatively long tail. The species is described essentially as follows: fur long, soft, and loose, about 12 mm. in length in winter. Above, rather darker than hair brown, passing into smoke gray below; ears scarcely projecting above the fur, grayish brown; feet grayish white; sole pads six as usual. Tail long, gray brown above, whitish below. Mammary eight, two pairs pectoral, two abdominal.

The skull is delicate and lightly built, with a long, flattened oval brain case, lacking marked ridges or angles. The interorbital region is smooth, not ridged. The posterior palate is normal, as in typical *Microtus*, its lateral pits of medium depth. The first upper molar has the usual five spaces, including an anterior transverse prism, succeeded by four alternating closed triangles, making three salient angles on each side. The second upper molar is remarkable in having a large postero-internal projection, making three angles on the inner as well as on the outer side. The third upper molar has the usual transverse prism, succeeded by two triangles, an outer and an inner, which are confluent with each other, while the termination of the tooth is the usual C- or U-shaped loop, making three outer and three inner salients. In the lower jaw the first molar is again peculiar in having but four closed triangles ahead of the posterior transverse space, while the fifth or anteriormost triangle is united to the anterior trefoil, making five inner and four outer salients. The second lower molar has the anterior two of the usual five spaces confluent. A rather striking peculiarity which this species shares with *M. clarkei* lies in the noticeably shallow lateral pits, hardly excavated deeper than the palatal surface. The skull is flattened above; the auditory bullae are well rounded, and in profile the supraorbital border is depressed.

In one of the original series the tip of the anterior trefoil of the first lower molar curls about inward, so that there are six salients on the inner side instead of the usual five, and four on the outer side. Similarly, in the last upper molar the terminal lobe, instead of being in the axis of the tooth row, may bend about to the inner side.

Measurements.—The type measured: head and body, 90 mm.; tail, 53; hind foot, 18.5; ear, 14.

CRANIAL MEASUREMENTS OF *MICROTUS MILLICENS*

No.	Greatest length	Basal length	Palatal length	Zygomastic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
11.9.8.103 BM	23.7	22.0	13.2	12.9	11.4	4.6	5.6	5.6	Szechwan
11.9.8.104 BM	24.5	23.0	13.5	13.0	11.4	4.6	5.6	5.5	Szechwan
11.9.8.105 BM (type)	24.7	22.9	13.4	13.5	11.3	4.7	5.7	5.6	Szechwan
11.9.8.106 BM	24.6	22.8	13.7	13.6	11.5	4.7	5.8	5.8	Szechwan
11.9.8.107 BM	24.3	22.8	14.0	13.8	11.1	4.7	5.5	5.7	Szechwan
11.9.8.108 BM	24.5	22.7	13.6	13.1	11.3	4.8	5.7	5.5	Szechwan

Occurrence and Habits.—This peculiar vole is as yet known only from the type series collected at Weichow in the narrow Si Ho valley, sixty miles northwest of Chengtu in northwestern Szechwan. According to the collector's note, they were taken "in forest." In general appearance this is a smaller form of *M. clarkei* with which its relationships seem to be, but whether nearer than specific is at present indeterminable. It agrees with that species in the rather long tail, noticeably shallow post-palatal pits, and the presence of an additional postero-internal angle on the second upper molar. Additional peculiarities are the confluence of the two triangles on the third upper molar, and in the lower jaw the confluence of the anteriormost or fifth triangle with the anterior trefoil as well as the union of the two anterior triangles of the second molar.

Specimens examined.—The original series of six, including the type, in the British Museum, from Weichow, Szechwan.

378. *Microtus agrestis mongol* Thomas

Microtus agrestis mongol Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 8, p. 759, 1911; *ibid.*, vol. 9, p. 398, 1912.

Type specimen.—A male, skin and skull, No. 12.4.1.102, British Museum, from Kentchik valley, Tannu Ola, northwestern Mongolia, 4,200 feet altitude. Collected August 4, 1910, by Douglas Carruthers.

Description.—With the general appearance of a large meadow mouse of the *M. pennsylvanicus* group, the upper surface of head and body a warm dark brown, nearly "Prout's brown," a result of the usual mixture of long all-black hairs with hairs having a dark slaty base, and a terminal ochraceous-buff portion. With a lens it is seen that these latter hairs comprise both the longer overlying guard hairs and the minute tips of finer under fur. The faintly ruddy effect is especially noticeable across the back. Under side of the body, except sometimes on the chin, with the hairs bluish gray at the base and tipped

with buffy white. Backs of the feet clothed with short silvery and drab hairs, giving a whitish effect in some lights. Tail bicolor, brownish black above, whitish below.

The skull is large and stout, with the posterior part heavily ridged, but the parietals almost smooth, even when the interorbital region is provided with a knife-edge crest. Its upper profile is flattened, but the rostrum is depressed. Ear bullæ large, their extreme length equaling the length of the orbito-temporal fossa. The teeth are of the usual type in the subgenus, except that the second upper molar has a well-developed postero-internal triangle about half the size of the one in front of it, so that the first and second molars have each three outer and three inner salient angles. The first lower molar has the usual five closed triangles in advance of the posterior transverse loop, with an anterior trefoil, in which the two lateral wings are both well developed as sharp lateral angles.

Measurements.—Available measurements include those of the type and of two other specimens from beyond the border of Mongolia near Lake Baikal:

No.	Head and body	Tail	Hind foot	Ear	Locality
12.4.1.102 BM (type)	98	32	18.0	12.0	Mongolia
22315 MCZ	126	41	17.7	13.7	Siberia
23972 MCZ	126	34	17.8	13.5	Siberia

CRANIAL MEASUREMENTS OF *MICROTUS AGRESTIS MONGOL*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width outside molars	Upper cheek teeth	Lower cheek teeth	Locality
22315 MCZ	26.3	24.6	14.9	15.4	12.5	5.5	6.6	6.5	Siberia
23972 MCZ	28.4	26.5	14.3	15.5	14.2	5.1	6.5	6.5	Siberia
12.4.1.102 BM (type)	25.9	24.3	14.0	14.2	12.0	4.8	5.7	5.9	Mongolia

Occurrence and Habits.—The discovery of a vole of this type in eastern Asia was one of the interesting results of Douglas Carruthers's expedition to extreme western Mongolia. The single specimen that he obtained indicates that this race is uncommon, and probably just extends far enough south in this region to enter the mountain valleys of the Altai. Later, Vinogradov and Obolenski discovered it in some numbers about the southwest shores of Lake Baikal, but very likely it does not occur along the northern edge of the Gobi. It belongs to the group of typical *Microtus* in which there is an additional and well-developed enamel triangle on the inner side of the second upper molar posteriorly, and is thus shown to be represented from western Europe (typical *M. agrestis*) to Transbaikalia, and in North America by the widespread *M. pennsylvanicus* and its races. No doubt a former land connection made possible the crossing over of this type from one continent to the other.

Specimens examined:—Two, from Lake Baikal, Siberia (M.C.Z.), and the type from Tannu Ola, Mongolia (B.M.).

Subgenus *Stenocranius* Kastschenko

Stenocranius Kastschenko, Annuaire Mus. Zool. Acad. Imp. Sci. St. Pétersbourg, vol. 6, p. 167, 1901.

Steneocranius Trouessart, Cat. Mamm. Viv. Foss., p. 457, 1904.

The voles of this subgenus are chiefly notable for the slenderness and narrowness of their skulls. The teeth and the palatal region are as in the subgenus *Microtus*, but the general outline of the skull is very much narrower, and slightly longer in proportion. The zygomatic arches, instead of spreading widely, bow forward a little at the anterior roots, and then turn nearly straight back, continuing almost parallel with each other to the squamosal region. The brain case, instead of being nearly circular in general outline, is much narrowed, maintaining about the same diameter from the lambdoid region forward to the weakly developed postorbital ledges, whose angles form the anterior corners of the rectangular cranium. The interorbital region is rather longer than usual in *Microtus* proper, with a narrow interorbital distance and a sharp dorsal ridge, characters which tend to accentuate the narrow and drawn-out appearance. The group appears to be confined to the northern part of the north temperate region in the Old World, and is typified by the species *M. slowzowi*. One species is common in parts of northern Mongolia, where it apparently represents *M. gregalis* of eastern Siberia, and a second is rarer, closely allied to *M. tianshanicus*. Ognev (1923) has described as *Stenocranius kossogolicus* a representative of the group from Kosso Gol, northwestern Mongolia, which is possibly a synonym of *raddei*.

KEY TO MONGOLIAN SPECIES OF *Stenocranius*

- A. Microtines with slender, elongate, narrow skulls.
 - a. Color dark brownish..... *M. gregalis raddei*
 - b. Color pale buffy..... *M. tianshanicus angustus*

379. *Microtus gregalis raddei* (Poliakov)

Arvicola raddei Poliakov, Mém. Acad. Sci. St. Pétersbourg, (8vo), vol. 39, p. 87, 1881. Poliakov and Lataste, Ann. Mus. Civ. Storia Nat., Genova, vol. 20, p. 299, 1884.

Arvicola arvalis Radde, Reisen im Süden von Ost-Sibirien, vol. 1, p. 193, pl. 7, fig. 9, a-d, 1862 (not of Pallas).

Microtus (Stenocranius) raddei Kastschenko, Annuaire Mus. Zool. Acad. Imp. Sci. St. Pétersbourg, vol. 6, p. 179, 1901.

Stenocranius kossogolicus Ognev, Bull. Soc. des Naturalistes Moscou, sect. biol., new ser., vol. 31, p. 80, text figs. 18-20, 1923. Kosso Gol, northwestern Mongolia.

Microtus (Stenocranius) angustus G. M. Allen, Amer. Mus. Novitates, no. 133, p. 9, 1924 (not of Thomas).

Microtus (Stenocranius) gregalis raddei Vinogradov and Obolenski, Journ. Mammalogy, vol. 8, p. 236, 1927.

Type specimen.—No type specimen is indicated. The name is based, however, in part on Radde's account of the voles he recorded as *Arvicola arvalis*, and principally on certain of the specimens he collected, of which Poliakov specifically mentions three, namely: Nos. 49, 51 from the borders of Tarei Nor in southern Transbaikalia, and No. 469 in alcohol, from Dauria. These are in the collection of the Zoological Museum of the Academy of Sciences at Leningrad.

Description.—In its general coloring this vole is buff to pale buff above considerably lined with black, and is thus rather similar in superficial appearance to *Microtus brandtii*, but is more heavily lined with black hairs, and is smaller in all its proportions, as well. The sides are clearer buff, and the lower surface of the body and limbs is whitish, the hairs gray-based, tipped with soiled whitish, or very pale buff, except on the chin where they are whitish to the base. Backs of the feet buffy white. Tail mixed black and buff above, pale buffy below, with a slight pencil of hairs at the tip. Claws whitish.

The skull is small and delicate, with narrow interorbital region which is sharply ridged in adults. The brain case elliptical, narrow, and smooth, the lambdoid crests appearing at the sides only. Rostrum short and depressed. The zygomata, as usual in the subgenus, are very little expanded, the distance across them being almost exactly one-half the total length of the skull. The teeth are of the pattern usual in the *M. arvalis* group, the first upper molar with four, the second with three closed triangles behind the anterior prism. The third upper molar has the usual transverse space, followed by two outer closed triangles and one inner closed triangle, and a terminal C-shaped loop, in which, however, there is a tendency for the inner enamel wall to close, or nearly close, dividing the C in halves. The first lower molar has the posterior transverse space and five closed triangles, with an anterior trefoil in which the outer and inner lateral wings are about equally developed, and strongly angular.

Measurements.—This is a smaller animal than *M. brandtii*, found in the same districts with it. The feet are smaller and the tail is less than twice the length of the foot. The following dimensions were taken from fresh specimens in the field:

No.	Head and body	Tail	Hind foot	Ear	Locality
45847	112	16	18	12	Mongolia
45880	114	22	18	11	Mongolia
57519	110	24	16	12	Mongolia
57526	110	25	15	10	Mongolia
57537	120	23	15	10	Mongolia
57553	110	22	16	10	Mongolia

CRANIAL MEASUREMENTS OF *MICROTUS GREGALIS RADDEI*

No.	Greatest length	Basal length	Palatal length	Zygomastic width	Mastoid width	Width outside molars	Upper cheek teeth	Lower cheek teeth	Locality
45847	25.7	24.2	14.6	13.6	10.9	4.4	6.0	5.8	Mongolia
45868	24.0	22.6	13.7	12.6	10.5	4.5	5.6	5.8	Mongolia
45905	24.6	23.3	14.3	13.0	10.8	4.7	6.2	5.8	Mongolia
45901	27.9	26.5	16.0	14.6	11.6	4.8	6.5	6.5	Mongolia
57519	25.1	23.5	14.0	13.0	10.6	4.5	5.7	5.7	Mongolia
57526	26.5	25.0	14.6	14.0	11.5	4.5	5.7	6.4	Mongolia
57537	26.9	25.2	14.9	13.6	11.2	4.8	5.7	5.8	Mongolia
57553	25.1	23.5	14.3	12.9	11.0	4.5	5.5	5.5	Mongolia

Nomenclature:—Originally recorded as *Arvicola arvalis* by Radde, this vole was renamed *A. raddei* by Poliakov in 1881 on the basis of his description, on the supposition that it was a distinct species. Its relationship, however, seems to be with *Microtus gregalis*, as shown by Vinogradov and Obolenski (1927). These authors had access to Radde's material collected in southern Dauuria, and suggest that *Microtus angustus* Thomas, described from specimens taken one hundred miles northwest of Kalgan on the Mongolian plateau, is the same, a view in which I at first concurred, but an examination of the type in the British Museum proves that the two are distinct. Ognev's *Stenocranius kossogolicus* from western Mongolia seems to be quite the same in measurements and skull characters, so that I have ventured to regard it as a synonym.

Occurrence and Habits:—This is apparently a common species in northern Mongolia and extends southward across the Gobi in the open grasslands to the region about Kalgan. On his way across the desert to Urga, Dr. R. C. Andrews secured a large series at localities one hundred and forty, one hundred and twenty, and sixty miles southeast of Urga, and again forty-five miles northeast of the same locality. To the westward he found it abundant at Sainnoin Khan. In contrast to many species of *Microtus*, it is an inhabitant of the dry steppe, and its pale color reflects the arid nature of its environment. Vinogradov and Obolenski (1927) report it abundant about the type locality, Tarei Nor, near the border of Mongolia and Transbaikalia.

Specimens examined:—In all, one hundred and five, as follows:

Mongolia: one hundred and forty miles southeast of Urga, 32; one hundred and twenty miles southeast of Urga, 12; sixty miles southeast of Urga, 4; forty miles southeast of Urga, 2; forty-five miles northeast of Urga, 15; Sainnoin Khan, 39; Ongin River, 1.

380. *Microtus tianshanicus angustus* Thomas

Microtus angustus Thomas, Proc. Zool. Soc. London, 1908, p. 108.

Type specimen:—An old male, skin and skull, No. 8.3.5.63, British Mu-

seum, from the Mongolian plateau, one hundred miles northwest of Kalgan, altitude 5,000 feet. Collected August 4, 1907, by Malcolm P. Anderson.

Description.—This is a pale-yellowish vole of the narrow-skulled type, in general color above, a uniform dull buffy, slightly clearer on the flanks, and with a somewhat contrasted oval spot in front of the hips of a clear ochraceous buff, probably marking the location of a lateral gland. Backs of the feet clear pale buffy; the tail clothed with short hairs, mostly clear buff above, slightly mixed with dark brown, while the under side is white. Ears small, nearly buried in the fur, their inner surface lined with scattered buffy hairs, and a tuft of brighter ochraceous hairs at the base externally. The darker hairs of the back are brownish rather than deep black, and so few and so evenly scattered that they merely dull the buffy effect without greatly darkening the upper surface. The ventral surface of the body has the hairs everywhere gray at the base except on the chin, tipped with buffy white. In comparison with *M. tianshanicus* from the Tien Shan area, this is a very slightly paler race, lacking in summer coat the faintly rusty tint on the lower back, and the darker upper surface of the tail.

The skull is quite like that of *M. tianshanicus*. The profile has the outline of the rostrum sharply depressed. The palate has two deep grooves commencing at the incisive foramina and continuing posteriorly into the lateral pits, which are deep. The interpterygoid fossa ends in a forwardly convex arch forming the posterior edge of the palate. The teeth are of the usual type, the last upper molar with a transverse prism, two small outer and one larger inner triangle, all closed, and a terminal crescent. The first lower molar has five, the second four tightly closed triangles.

Measurements.—The type and three other specimens in the British Museum were measured by the collector as follows:

No.	Head and body	Tail	Hind foot (s. u.)	Ear	Locality
8.3.5.63 BM (type)	112	32	17	10.5	Mongolia
5.2.1.9 BM	103	28	16	11.0	Mongolia
12.4.1.105 BM (im.)	81	23	15	10.0	Mongolia
8.11.6.9 BM	113	27	(13)	9.0	Mongolia

CRANIAL MEASUREMENTS OF *MICROTUS TIANSHANICUS ANGUSTUS*

No.	Greatest length	Basal length	Palatal length	Zygomastic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
8.3.5.63 BM	26.8	25.4	14.9	12.7	11.0	4.7	5.8	5.7	Mongolia
5.2.1.9 BM	25.1	23.3	14.3	12.8	10.5	4.7	6.0	6.0	Mongolia
5.2.1.7 BM	24.1	22.3	13.6	11.5	10.5	4.4	5.7	5.7	Mongolia
98.2.6.6 BM	24.9	23.5	14.2	12.5	10.6	4.4	5.8	5.9	Mongolia
12.4.1.107 BM	24.0	22.3	13.5	10.4	9.9	4.1	5.8	5.5	Mongolia
12.4.1.113 BM	24.6	23.0	13.7	11.5	10.6	4.4	5.7	5.5	Mongolia

Nomenclature.—In describing this as a distinct species, Thomas compared it with the dark *M. mongolicus*, the smaller *M. raddei* and *M. gregalis*, adding that it is so remote from *M. tianshanicus* and *M. slowzowi* "that it cannot possibly be either of them." Nevertheless, a comparison of the type and other specimens in the British Museum since acquired shows clearly that it is so close to the former as to be barely distinguishable by its paler color. I had previously identified as this subspecies the series of *M. gregalis raddei*, working from descriptions alone, but the latter is a dark species and quite distinct.

Occurrence and Habits.—This seems to be a rare species of the narrow-skulled type, occurring throughout the Gobi area in suitable localities. The pale-buffy coloring is different from that of other microtines of the region except *M. brandtii* which it rather resembles externally but is smaller, and of course with different cranial characters. In addition to the type specimen taken on the Mongolian plateau, one hundred miles northwest of Kalgan, the British Museum has a few specimens from localities far apart over the Gobi, including one from Balbur Sumu, and one from the Kerulen River, both in northeastern Mongolia, and three from localities in the Great Altai, extreme northwestern Mongolia. All these seem referable to this pale race, while others from the Barlik Mountains, northwestern Dzungaria, labeled *M. tianshanicus* by Thomas, are either indistinguishable or intermediate between the two. The type was caught by Anderson "by hand among grass and weeds in the middle of the afternoon. No other specimens could be found, and there were no burrows about." The Altai specimens were apparently secured also in grassland, for the notes on the labels indicate that they were trapped on upland grassy downs at 6,000-8,000 feet altitude. They seem to be uncommon or difficult to trap in these areas.

Specimens examined.—Seven, as follows:

Mongolia: one hundred miles northwest of Kalgan, 1, the type (B.M.); Balbur Sumu, 1 (B.M.); Kerulen River, 1 (B.M.); Chagan Gol, Great Altai, East, 3 (B.M.); Suok, 1 (B.M.).

Subgenus **Neodon** Hodgson

Neodon Hodgson, Ann. Mag. Nat. Hist., ser. 2, vol. 3, p. 203, 1849 (as a genus). Hinton, Monogr. of Voles and Lemmings, vol. 1, p. 57, 1926 (as a genus).

As pointed out by Hinton (1926, p. 57), the microtines referred to *Neodon* are in dental characters quite like *Pitymys*, but whereas the latter have become modified for a more fossorial and subterranean existence through the reduction in size of the eyes, external ears, and tail and the development of a closer, more velvety type of pelage, the members of the *Neodon* group retain the more primitive terrestrial habit and are thus in general external appearance like

typical *Microtus*, with eyes, ears and tails not especially reduced in size, and the fur more full and shaggy. Indeed, so far as tooth pattern goes, the excellent figures given by Hinton (1926, pp. 56, 57, figs. 29a, b) of the enamel outline of *Neodon sikimensis* may readily be seen to be practically identical with those of *Pitymys* on a previous page. In contrast to *Eothenomys* and *Antelionomys*, the five enamel spaces of the first upper molar and the four of the second are all separate, due to the deep outer reëntrant angles that cut quite across to the opposite enamel wall, while in the last upper molar the first outer reëntrant, instead of being so shallow as to leave the first and second salients in confluence, is again deeper, cutting off completely a small outer triangle just behind the anterior transverse prism. In addition, the first and second molars show little tendency toward the development of an additional angular projection on the postero-internal border, so that the second upper molar has three outer and but two inner prominent angles. In the lower jaw the first molar, as in *Pitymys*, has but three closed triangles in advance of the posterior transverse prism, for the fourth and fifth spaces are widely confluent and separate from the anterior trefoil, the lateral petals of which, especially the inner, are of variable development. Another point of difference from *Pitymys* lies in the retention of the primitive number of mammæ, two pairs pectoral, two pairs inguinal. Other characters are: the moderately large ears with a distinct antitragus, the fore and hind claws about equally developed, the sole of the foot with six pads, sometimes reduced to five, the normal palate, and the very slight development of spongy bone within the auditory bullæ (Hinton). According to Hinton, this group is represented in North America by the group *Pedomys* (*Microtus ochrogaster*). The type of the subgenus is *Neodon sikimensis* of India.

Two species, a smaller and a larger, occur in China, which with a subspecies of the former may be distinguished by the following characters.

KEY TO THE CHINESE SPECIES OF THE SUBGENUS *Neodon*

- | | |
|--|-------------------------|
| A. Smaller, head and body about 80-105 mm., skull length 24 mm. or less. . | <i>M. irene</i> |
| a. Larger, head and body about 90-105 mm., tail 25-30 mm. | <i>M. irene irene</i> |
| b. Smaller, head and body about 80 mm., tail 25 mm. | <i>M. irene oniscus</i> |
| B. Larger, head and body averaging about 120 mm. | <i>M. forresti</i> |

381. *Microtus irene irene* Thomas

Microtus irene Thomas, Abstract Proc. Zool. Soc. London, February 14, 1911, p. 5; Proc. Zool. Soc. London, 1911, p. 173.

Microtus mandarinus G. M. Allen, Mem. Mus. Comp. Zool., vol. 40, p. 210, 1912 (not of Milne-Edwards).

Neodon irene Hinton, Ann. Mag. Nat. Hist., ser. 9, vol. 11, p. 156, 1923; Monogr. of Voles and Lemmings, vol. 1, p. 56, text figs. 29a, b, no. 3, 1926.

Microtus (Neodon) irene G. M. Allen, Amer. Mus. Novitates, no. 133, p. 9, 1924.

Type specimen.—An adult female, skin and skull, No. 11.2.1.195, British Museum, from Tatsienlu, central Szechwan (now Hsikang), China. Collected July 2, 1910, by Malcolm P. Anderson.

Description.—A rather small grayish-brown species, with tail less than twice the length of hind foot, ears projecting beyond the fur, hind foot about 18 mm.

The general color of the dorsal surface is about "bistre" of Ridgway, due to a liberal mixture of all-black hairs with others having the usual slaty base and a pale ochraceous or buffy tip. It is the paleness of this tip that causes the grayish-brown general appearance. Backs of the feet pale brown, about "bistre." Chin and bases of the hairs below dark slaty gray, the tips of the hairs of chest and belly whitish, with in some specimens a very faint buffy wash across the chest. Tail bicolor, like the back above, whitish below. The two tarsal pads on the sole of the hind foot are of about equal size, nearly circular, and placed one directly behind the other, but not quite in contact.

The skull is delicate, with narrow slender rostrum, the upper profile of which is slightly curved downward. Interorbital space narrow, with the post-orbital projection a mere ridge. The narrowness of this space makes the anterior end of the brain case more truncate, giving it a nearly circular outline. The palate is like that of typical *Microtus*, with a median upwardly sloping termination, joining the lateral pits, instead of ending in a transverse shelf ventral to the pits as in *Eothenomys* and its allies. The audital bulla, if broken open, shows an inner layer filled with spongy bone for about one-half of its diameter. The first upper molar consists of a transverse space and four closed triangles, making three salients on each side. The second molar has but three closed triangles in addition to the anterior transverse prism, making three outer and but two inner salients. Both teeth end posteriorly with a rather square inner outline, but this is not prolonged on the lingual side to form a projecting angle. The third upper molar consists of a transverse prism, followed by an outer and an inner closed triangle, then a terminal trefoil, the median leaf of which is the heel of the tooth. In the lower jaw the first molar consists of a posterior transverse prism, in advance of which are three closed triangles, then two opposite triangles with their inner portions confluent, and opening into the anterior trefoil whose outer lateral petal is much smaller than the inner. Cement is not noticeably developed. The second lower molar consists of a posterior transverse space, in front of which are two alternating pairs of triangles, of which the two anteriormost are minutely in communication. The last lower molar consists of three transverse loops.

Measurements.—The following measurements were made from the fresh specimens by the collectors in the field:

No.	Head and body	Tail	Hind foot	Ear	Locality
44215	90	31	19.0	—	Yunnan
44219	85	28	18.0	—	Yunnan
44226	83	26	17.5	—	Yunnan
44229	90	28	19.0	—	Yunnan
7793 MCZ	92	28	17.0	—	Szechwan
7795 MCZ	96	23	16.0	—	Szechwan
7796 MCZ	101	24	16.0	—	Szechwan
7797 MCZ	107	27	17.0	—	Szechwan
11.2.1.189 BM	96	40	18.0	13	Szechwan
11.2.1.191 BM	94	38	18.0	13	Szechwan
11.2.1.193 BM	96	36	18.0	13	Szechwan

CRANIAL MEASUREMENTS OF *MICROTUS (NEODON)*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width outside molars	Upper cheek teeth	Lower cheek teeth	Locality
<i>M. irene irene</i>									
44215	24.2	22.5	13.8	14.0	11.7	4.7	5.4	5.6	Yunnan
44219	23.7	22.2	14.1	13.8	11.8	4.8	5.7	5.5	Yunnan
44226	22.6	21.0	13.0	13.3	11.6	4.8	5.4	5.7	Yunnan
44229	24.0	22.2	13.7	13.6	12.0	4.7	5.8	5.7	Yunnan
7796 MCZ	22.7	21.0	13.1	13.5	11.2	4.7	5.6	5.5	Szechwan
11.2.1.195 BM	24.5	23.0	14.0	14.4	11.5	5.0	5.9	5.7	Szechwan
22.4.29.8 BM	23.3	21.2	13.3	13.7	11.5	4.7	5.7	5.5	Szechwan
23.3.7.14 BM	23.7	22.4	13.5	14.2	11.5	4.8	5.9	5.5	Szechwan
12.3.18.12 BM	24.5	22.4	13.7	13.7	11.8	4.6	5.8	5.7	Yunnan
12.3.18.13 BM	24.8	22.7	13.8	14.6	12.3	4.9	5.9	5.7	Yunnan
<i>M. irene oniscus</i>									
84233	22.2	20.6	12.6	13.0	11.0	4.7	5.4	5.2	Kansu
84243	22.5	21.3	13.0	(13.0)	10.9	4.6	5.2	5.1	Kansu
12.8.5.41 BM	24.1	22.4	13.4	14.4	11.0	4.6	5.6	5.7	Kansu
12.8.5.43 BM	24.0	21.8	13.0	12.6	11.7	4.6	5.5	5.4	Kansu
12.8.5.44 BM	21.5	20.1	12.5	13.2	10.9	4.5	5.1	5.7	Kansu
12.8.5.45 BM	22.6	20.8	12.6	13.0	11.2	4.7	5.9	5.9	Kansu
12.8.5.46 BM	22.2	20.8	12.6	13.6	10.7	4.5	5.3	5.3	Kansu
11.11.1.3 BM (type)	22.0	20.5	12.5	13.0	10.6	4.5	5.4	5.5	Kansu
<i>M. forresti</i>									
22.9.12.41 BM	27.6	—	15.8	16.0	—	5.5	6.7	5.8	Yunnan
22.12.1.34 BM	27.0	—	15.8	14.9	—	5.3	6.5	6.0	Yunnan
22.12.1.35 BM (type)	28.6	26.2	16.6	16.8	—	5.5	6.8	7.0	Yunnan
22.12.1.36 BM	—	—	16.2	16.9	—	5.4	6.3	5.8	Yunnan
22.12.1.37 BM	25.3	23.9	14.7	14.8	13.0	5.3	6.0	5.8	Yunnan
22.12.1.38 BM	27.5	26.1	15.5	—	12.9	5.6	6.5	6.5	Yunnan
22.12.1.39 BM	25.7	23.7	—	14.8	12.2	5.5	5.8	5.6	Yunnan
22.12.1.42 BM	26.8	25.7	15.8	16.5	—	5.5	6.0	6.5	Yunnan

Occurrence and Habits.—This small microtine, with its small hind foot, short tail, fine brownish-gray fur, and rather pale feet, has a wide distribution in the highlands of western China at high altitudes. Originally described in 1911 from a series taken by Anderson in the vicinity of Tatsienlu, Szechwan (Hsikang), at altitudes of from 9,000 to 12,000 feet, it was secured actually three years earlier (1908) by W. R. Zappey at some distance to the northwestward at Shuowlow (13,000 to 15,000 feet) and at the Ramala Pass (16,000 feet), these being the same specimens that I (1912) recorded as *Microtus mandarinus*. Shortly after, Thomas (1912b, 1914b) recorded others from extreme northwestern Yunnan at Atuntze (14,000 to 16,000 feet) and from the Mekong-Yangtze divide (14,000 feet) and Kagurpu (15,100 feet). In 1916 Dr. Roy C. Andrews and Edmund Heller secured a fine series at Peitai, some thirty miles south of Chungtien. The range, on the basis of these records, would be central Szechwan and northern Yunnan at high altitudes. On his recent expedition

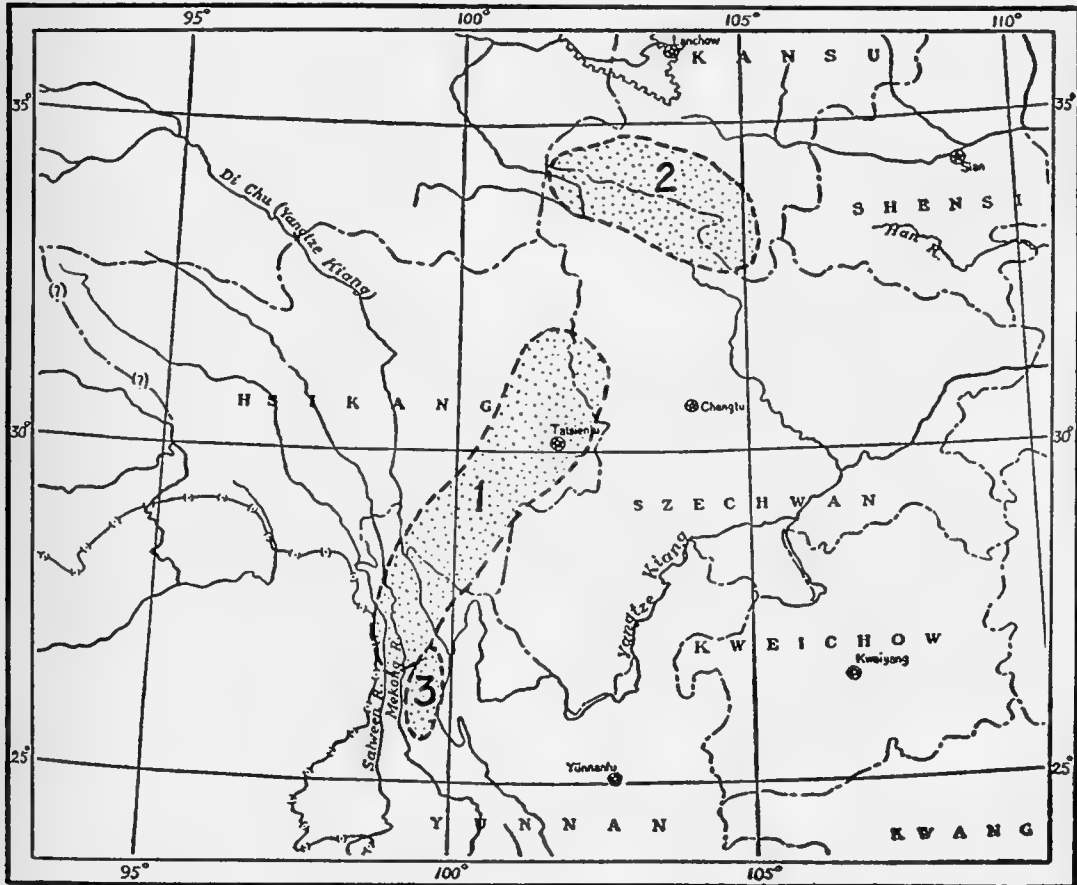


FIG. 38. Distribution Map.
Microtus

1. *M. irene irene*

2. *M. irene oniscus*

3. *M. forresti*

to eastern Tibet, Brooke Dolan secured one at forty miles east of Hokow, four from Batang, and others still farther to the westward in Kham, thus extending its range into the eastern edge of the Tibetan plateau. Abundant trapping on the isolated Likiang Range in the big bend of the Yangtze to the south of these points curiously resulted in demonstrating the apparent absence of this mouse from the alpine meadows of that area. In commenting on the presence of these terrestrial representatives of the *Pitymys* group in China, Hinton (1926, p. 56) argues that "in those parts of the highlands of south-eastern Central Asia, where no species of *Microtus* occurs, members of the *Pitymys* group have been able to persist on the surface of the ground, leading the lives of normal Microtines, and they have undergone a process of cranial specialization exactly parallel with that which, in other places, has been undergone by the species of *Microtus*." They inhabit alpine meadows or dry shrubby banks on mountain sides, and several were trapped in fields of rape seed. A female taken August 18, 1921, held three nearly mature embryos.

Specimens examined:—The following fifty-seven:

Szechwan (Hsikang): Ramala Pass, 3 (M.C.Z.); Shuowlow, 3 (M.C.Z.); Tatsienlu, 9, including the type (B.M.); Muli, 5 (B.M.); Kulu, fifty miles south of Muli, 3 (B.M.); forty miles east of Hokow, 1 (A.N.S.P.); Batang, 4 (A.N.S.P.).

Yunnan: Peitai, thirty miles south of Chungtien, 22; Atuntze, 3 (B.M.); Moting, 1 (B.M.); Tutsenla, east of Atuntze, 1 (B.M.); Paima Shan, Atuntze district, 2 (B.M.).

382. *Microtus irene oniscus* Thomas

Microtus oniscus Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 8, p. 723, 1911.

Neodon oniscus Hinton, Ann. Mag. Nat. Hist., ser. 9, vol. 11, p. 156, 1923; Monogr. of Voles and Lemmings, vol. 1, p. 56, text figs. 29a, b, no. 5, 1926.

Type specimen:—A skin and skull, No. 11.11.1.3, British Museum, from Taochow, Kansu, China. Collected April 10, 1911, by J. A. C. Smith.

Description:—This is a very poorly marked race, similar in all respects to typical *M. irene*, but apparently slightly smaller, and with shorter tail. Laid out in series, it is possibly a shade grayer.

The skull of the type has the upper outline not so flat as in *M. irene*, and m^3 with the posterior lobe simple as in the latter.

Measurements:—The type measured: head and body, 80 mm.; tail, 25; foot, 15.5; ear, 11.

Skull of the type: condylo-incisive length, 22.2 mm.; condylo-basal length, 22.0; zygomatic width, 13; upper molars, crowns, 5.2. For additional skull measurements, see table under *M. irene*.

Occurrence and Habits:—It seems extremely doubtful if this subspecies can be maintained. The type is an unusually small, perhaps rather young

individual whose teeth differ only in their slightly smaller size from those of the typical race, as shown by Hinton's (1926, pp. 56, 57) figures. A series from Archuen and the mountains southwest of Choni in Kansu is almost indistinguishable externally from the Yunnan series, and can hardly be very different from the animal of Taochow, the type locality, at no great distance to the northwest.

Specimens examined.—The following twenty-seven are provisionally assigned to this subspecies:

Kansu: Archuen, 12; near Choni, 6; forty miles southeast of Taochow, 9, including type (B.M.).

383. *Microtus forresti* (Hinton)

Neodon forresti Hinton, Ann. Mag. Nat. Hist., ser. 9, vol. 11, p. 156, 1923; Monogr. of Voles and Lemmings, vol. 1, pp. 56, 57, text figs. 29a, b, no. 2, 1926.

Type specimen.—An adult male, skin and skull, No. 22.12.1.35, British Museum, from the divide between the Mekong and Yangtze Rivers, in latitude 27° 30' north, Yunnan, China, altitude 11,000-12,000 feet. Collected July 6, 1921, by George Forrest.

Description.—This is rather similar to *M. irene* but considerably larger, with the tail averaging about 30 instead of 40 per cent of the head and body. In color it is a slightly darker brown instead of the distinctly grayish brown of *M. irene*, with much admixture of long black hairs peppered with ochraceous tips. Tail blackish above, white below, sharply bicolor. Feet whitish; belly with the hairs gray basally, tipped with whitish. The ears are small, hardly longer than the surrounding fur, the metentote covered with ochraceous and black hairs. The general appearance is much that of the common meadow mouse, of a general "mummy brown" above.

Skull larger than that of *M. irene* but otherwise not essentially different, except that the brain case is slightly longer and narrower. Teeth similar, lacking a distinct antero-external projection to the last lower molar, such as is present in *M. sikimensis*. In the last upper molar the terminal loop has a tendency in some specimens to curl inward, instead of being straight-sided, so that there may be four projections on the inner side instead of but three. The first lower molar has its anterior two triangles (fourth and fifth counting from the rear) confluent with each other, but shut off in front from the small anterior trefoil.

Measurements.—The following measurements were made in the field by the collector of the type series:

No.	Head and body	Tail	Hind foot (s. u.)	Ear	Locality
22.12.1.34 BM	125	40	17	13	Yunnan
22.12.1.35 BM (type)	134	43	18	14	Yunnan
22.12.1.36 BM	130	36	18	15	Yunnan
22.12.1.38 BM	112	40	19	14	Yunnan
22.12.1.39 BM	100	36	18	15	Yunnan
22.12.1.40 BM	112	38	18	15	Yunnan
22.12.1.41 BM	113	36	20	15	Yunnan
22.12.1.42 BM	115	37	18	15	Yunnan

For cranial measurements, see table under *M. irene*.

Occurrence and Habits.—On the basis of the material available, this appears to be a distinct species from *M. (Neodon) irene*, differing in its larger size and darker color. It may prove, however, that it is after all but a large southern subspecies. Yet should its specific distinction be finally proved, it would offer a parallel to the case of *Eothenomys miletus*, a larger, southern relative of *E. melanogaster*. As yet it seems to be known only from the original series collected by Forrest for the British Museum on the Mekong-Yangtze and the Mekong-Salween divides, between latitudes 27° 30' and 28° 28' north, and in the Mekong valley at an altitude of from 11,000-12,000 feet. The collector's note on the labels indicates that they were taken mostly among rocks and on alpine meadows.

Specimens examined.—In all, ten, as follows:

Yunnan: Mekong-Yangtze divide, 6 (B.M.); Mekong-Salween divide, 4 (B.M.).

Subgenus *Phaiomys* Blyth

Phaiomys Blyth, Journ. Asiatic Soc. Bengal, vol. 32, p. 89, 1863. Miller, North Amer. Fauna, no. 12, p. 56, 1896.

Lasiopodomys Lataste, Ann. Mus. Civ. Storia Nat., Genova, ser. 2, vol. 4, p. 268, 1887.

In his review of the subgenera of voles and lemmings in 1896, Miller combined *Phaiomys* and *Lasiopodomys* as a single group under the former name, but more recently Hinton has advocated the generic standing of both. Nevertheless it seems likely that the former course is preferable. Both have become modified slightly in external characters for a semifossorial life, in the shortening of the ears and tail, the slight enlargement of the fore claws, even the thumb having a short but well-developed claw rather than the usual nail. The last upper molar is fairly simple, consisting of an anterior transverse prism, followed by an inner and an outer closed triangle, and terminating in a trefoil, with an external and an internal arm, and a heel in the axis of the tooth. The second upper molar has the usual four spaces without indication of an additional postero-internal one. The first lower molar has four or five closed triangles

anterior to the transverse prism at the back of the tooth, and the anterior section, instead of being more or less of a trefoil, consists of a nearly squarish loop, so that there are five inner and four outer projections. The second lower molar consists of a posterior transverse prism and four closed, alternating triangles, while the last lower tooth has two posterior transverse prisms and an antero-external one. The mammæ are apparently the usual two pairs pectoral and two inguinal, making eight. The type of the subgenus is *Phaiomys leucurus* Blyth, which is a synonym of *Microtus blythi* Blanford. The type of *Lasiopodomys* is *Microtus brandtii* (Radde). Two species are referred to the subgenus.

KEY TO THE CHINESE AND MONGOLIAN SPECIES OF THE SUBGENUS *Phaiomys*

- A. Smaller, color tawny to buffy brown, hind foot 18 mm. or less *M. mandarinus*
 a. Color above, rich brown.
 a'. Hair of the ventral surface tipped with whitish, general color less dark. *M. mandarinus mandarinus*
 b'. Hair of the ventral surface strongly washed with buffy, general color darker. *M. mandarinus fæceus*
 b. Color above, pale ochraceous buff. *M. mandarinus johannes*
 B. Larger, color sandy buff, hind foot 19-20 mm. *M. brandtii*

384. ***Microtus mandarinus mandarinus*** (Milne-Edwards)

Arvicola mandarinus Milne-Edwards, Recherches pour servir à l'Hist. Nat. des Mammifères, p. 129, pl. 12, fig. 4; pl. 13, figs. 4-4d, 1868-74.

Microtus mandrianus (lapsus calami) Miller, North Amer. Fauna, no. 12, p. 57, 1896 (in subgenus *Phaiomys*).

Microtus mandarinus Thomas, Proc. Zool. Soc. London, for 1908, p. 976, 1909.

Microtus pullus Miller, Proc. Biol. Soc. Washington, vol. 24, p. 53, 1911. Chiao Cheng Shan, Shansi.

Microtus (Phaiomys) pullus A. B. Howell, Proc. U. S. Nat. Mus., vol. 75, art. 1, p. 52, 1929.

Type specimens.—No type is specified, but apparently Milne-Edwards had at least a male and a female which he describes. These were collected by Père Armand David "dans la Mongolie chinoise," meaning, doubtless, Saratsi, Shansi, China. Presumably the specimens are still in the Muséum d'Histoire Naturelle at Paris.

Description.—General appearance a good deal like that of a *Pitymys* with small short ears hardly projecting above the fur, and short tail slightly exceeding the hind foot in length; the fur, however, is thick and fairly long, about 11 mm. in the middle of the back in winter coat. The color is very characteristic: in winter a rich "pale tawny" to light "wood brown" above, slightly darkened in the median area by all-black hairs which on the sides are much less numerous so that the tawny is clearer. Backs of the feet whitish, washed

with buff on the metapodial portion. Entire lower surface with gray-based hairs tipped with whitish. Tail bicolor, like the back above, whitish below. In immature specimens the color is less warm tawny, but grayer above. Summer skins are thinner-haired, and slightly less tawny above and on the sides.

Skull fairly broad, the brain case flat above, the dorsal profile nearly straight except that of the rostrum which is slightly depressed. Nasals shorter than premaxillaries. Palate of the typical *Microtus* style, with a median bridge of bone joining the inner edges of the rather small lateral pits. Incisive foramina long and very narrow, slit-like. First upper molar with the usual transverse space followed by two outer and two inner triangles, alternating and closed, making three angular projections on each side. Second upper molar also of the usual type, with an anterior transverse prism, followed by two outer closed triangles and one inner closed triangle, alternating. The third upper molar consists of a transverse prism followed by a small outer and a larger inner closed triangle, and a nearly symmetrical trefoil, with the outer lateral leaf slightly in advance of the inner and sometimes nearly cut off, forming an outer open triangle, with the main lobe in the axis of the tooth row. The first lower molar has the usual posterior transverse prism, in front of which are three inner and two outer alternating and closed triangles, while the anterior lobe of the tooth is nearly square, with two corners on opposite sides of the tooth row, and the third at the anterior end. The second lower molar has two inner and two outer closed triangles and a posterior transverse prism. The third lower molar consists of two posterior transverse prisms and an inner anterior angle of somewhat trapezoidal shape, so that there are three inner and two outer salients.

Measurements.:—The following measurements are from the fresh specimens in the field:

No.	Head and body	Tail	Hind foot	Ear	Locality
45431	113	20.0	18.0	8.0	Shansi
45438	105	27.0	17.0	12.0	Shansi
45439	103	23.0	16.0	7.0	Shansi
45440	105	25.0	17.0	8.0	Shansi
PARIS (type)	105	20.0	16.0	12.0	Shansi
155045 USNM	100	20.0	16.5 (s. u.)	10.0	Shansi
172538 USNM	104	24.5	17.0 (s. u.)	10.0	Shansi
172583 USNM	97	20.0	15.0 (s. u.)	9.0	Shansi
172584 USNM	98	20.0	15.5 (s. u.)	8.5	Shansi

The measurements given by Milne-Edwards for the type are closely in accord with the specimens from Kweihwacheng (the first four recorded in the above table).

CRANIAL MEASUREMENTS OF *MICROTUS MANDARINUS*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width outside molars	Upper cheek teeth	Lower cheek teeth	Locality
<i>M. mandarinus mandarinus</i>									
45432	24.7	23.2	14.5	15.0	11.8	5.0	5.8	5.7	Shansi
155945 USNM	25.3	—	15.0	16.0	12.5	5.1	5.8	6.0	Shansi
172538 USNM	27.4	26.0	16.5	17.7	12.9	5.5	6.4	6.3	Shansi
172583 USNM	—	—	13.7	15.8	—	5.1	6.0	5.9	Shansi
10.5.2.72 BM	26.5	24.7	15.7	16.7	12.7	5.7	6.5	6.3	Shensi
<i>M. mandarinus johannes</i>									
172585 USNM	24.7	23.0	14.4	14.5	11.9	5.0	6.1	6.0	Shansi
172586 USNM	24.5	22.8	14.2	15.1	12.2	5.0	5.7	5.7	Shansi
172587 USNM	24.1	23.0	14.2	14.8	11.8	5.1	6.1	5.7	Shansi
172589 USNM	—	—	—	15.2	12.8	5.3	6.6	6.5	Shansi
9.1.1.178 BM (type)	24.6	23.2	14.2	14.7	12.2	5.6	5.9	6.5	Shansi
9.1.1.175 BM	24.6	22.8	13.9	14.6	12.6	5.0	5.7	5.7	Shansi
9.1.1.176 BM	24.7	23.1	14.0	15.3	12.5	4.8	5.7	5.8	Shansi
9.1.1.177 BM	26.0	24.3	14.8	15.5	12.2	5.6	6.3	6.2	Shansi
9.1.1.179 BM	23.7	22.0	13.7	14.6	11.8	4.8	5.8	5.7	Shansi
9.1.1.180 BM	25.0	23.7	14.3	15.1	12.4	5.2	6.2	5.8	Shansi

Nomenclature.—Although currently placed in the same subgenus as *Microtus brandtii*, this species is very different in outward appearance, and much more resembles the typical *Microtus* in its brownish-tawny fur and in the possession of five tightly closed triangles in the first lower molar. It is modified for fossorial life by the shortening of the tail, reduction of the external ears and in the very obvious flattening of the skull and the widely bowed zygomata. It may eventually prove best to place *M. brandtii* in a separate subgenus (*Lasiopodomys*) and erect a new one for *M. mandarinus*. Through the kindness of Mr. Gerrit S. Miller, Jr., I have had for examination two topotypes of his *M. pullus* which prove to be quite identical with typical *M. mandarinus*. In the original description the type series was contrasted only with the much paler *M. johannes*, and, furthermore, the dark appearance in comparison with available *M. mandarinus* was doubtless because only winter skins of the latter were studied, whereas the specimens of *M. pullus* are still in summer coat.

Occurrence and Habits.—The original specimens were sent to the Paris Museum from "Sartchy" or Saratsi in northern Shansi, so that the series of eleven brought back by Dr. R. C. Andrews from Kweihwacheng in the same vicinity are practically topotypes and afford a valuable basis for comparison with specimens from other parts of the species' range. Their identity with specimens described as *Microtus pullus* indicates that the range extends southward in the same province at least to its south-central part. Here Mr. Arthur

de C. Sowerby procured a few at fifty miles northwest and five miles south of Taiyuanfu, while the type series of *M. pullus* was from Chiao Cheng Shan, only ninety miles west of the same city. This well-known naturalist writes that they were caught on grassy hillsides away from woods, and that they may also be found in similar places up to 9,500 feet in high rocky mountains. They have a characteristic way of throwing out much earth in front of their burrows.

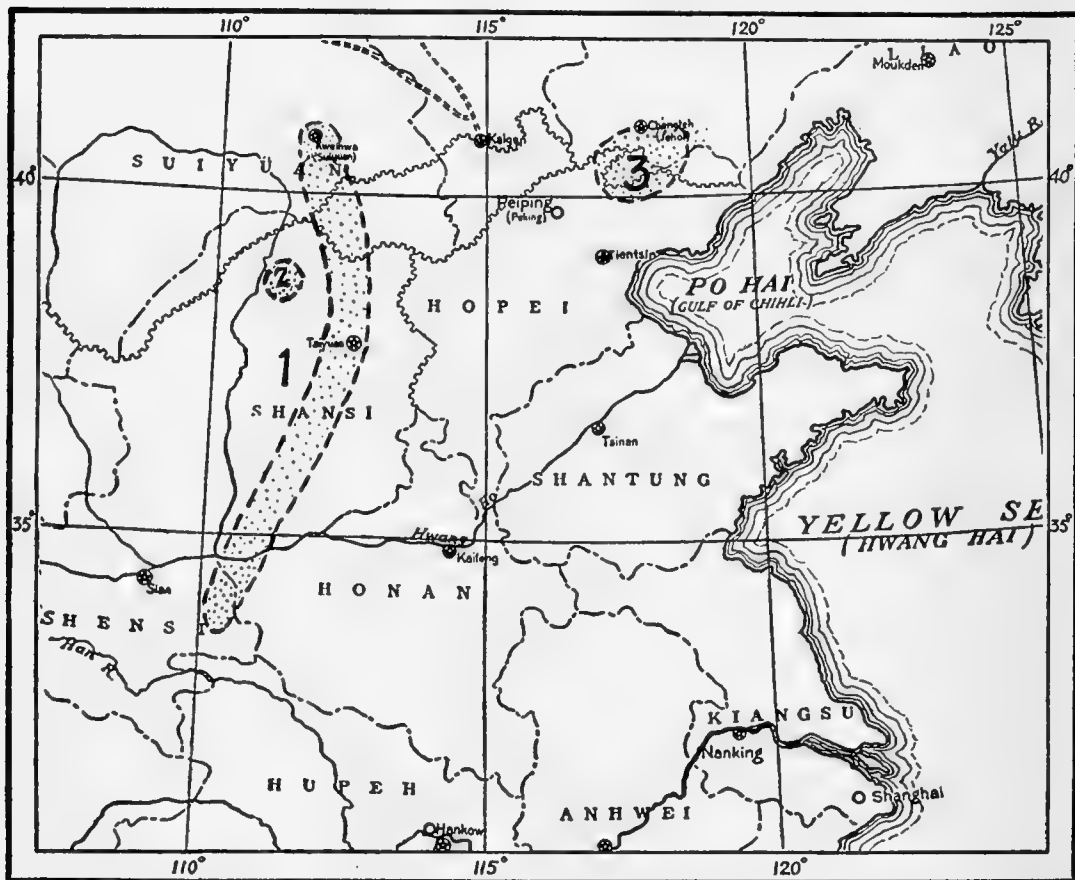


FIG. 39. Distribution Map.

Microtus

1. *M. mandarinus mandarinus* 2. *M. mandarinus johannes* 3. *M. mandarinus faecus*

The most southern record for the typical race as well as for the species is of a female from the Shangchow district in southeastern Shensi (Thomas, 1910b, p. 637; 1911e, p. 691).

Specimens examined.—In all, seventeen, as follows:

Shansi: Kweihwacheng, 11; fifty miles northwest of Taiyuanfu, 2 (U.S.N.M.); five miles south of Taiyuanfu, 1; Chiao Cheng Shan, ninety miles west of Taiyuanfu, 2 (U.S.N.M., topotypes of *M. pullus*).

Shensi: Shangchow district, 1 (B.M.).

385. *Microtus mandarinus fæceus* G. M. Allen

Microtus mandarinus fæceus G. M. Allen, Amer. Mus. Novitates, no. 133, p. 8, 1924.

Microtus jeholensis Mori, Rept. First Sci. Exped. to Manchoukuo, sect. 5, div. 2, pt. 4, p. 68 (English), pl. 9, March, 1939. Changshanyu, Jehol.

Type specimen.—An adult male, skin lacking skull, No. 56358, American Museum of Natural History, from one hundred miles northeast of Peiping, Hopei, China. Collected March, 1922, by the Central Asiatic Expeditions, Dr. R. C. Andrews, leader.

Description.—Similar to the typical *M. mandarinus*, but (in winter pelage) slightly darker above, with a darker slaty throat, belly with bases of the hairs darker slaty, and their tips washed with a decided tinge of buffy. General color above, a nearly uniform "hair brown" instead of the brighter "wood brown" of the typical race, as a result of the greater admixture of black hairs and the slightly narrower subterminal ochraceous rings of the parti-colored hairs, producing thus a darker and less buffy effect. The flanks are a slightly clearer buff, deeper in tone than in the typical form, "warm buff" instead of "light ochraceous buff." The ventral surface is very different. In the typical race the bases of the hairs are slaty gray, their tips whitish, with a faint wash of buffy over the chest and belly. In *M. m. fæceus* the slaty bases are darker, on the chin and upper throat lacking whitish tips, but indistinctly shaded with brownish; on the chest and belly the tips are "warm buff" instead of whitish, with more or less of the slaty bases showing through. Feet covered with short dusky and silvery hairs, the former more evident on the basal portion and on the metapodials. Tail bicolor, like the back above, buffy below. Ears small, concealed in the fur.

Measurements.—In general the size is much as in the typical race, but the feet seem to average slightly larger, 19 to 21 mm., against 17 or 18 in the latter.

If I am correct in considering Mori's *Microtus jeholensis* the same as *M. m. fæceus*, the following cranial measurements he gives may apply to the latter: condylobasal length, 26 mm.; zygomatic width, 17; interorbital constriction, 3.9; length of nasals, 6; diastema, 8.9; maxillary cheek teeth, 6.2.

Occurrence and Habits.—This darker race with larger hind foot is known from the dry country to the north of Peiping, and at Changshanyu, Jehol. The type locality is one hundred miles northeast of Peiping. Here, in response to a slightly less dry climate, subspecific differences have developed, visible especially in the color of the under side. In February and March, 1922, Dr. Andrews's expedition secured fourteen specimens. This species seems to occupy an ecological niche similar to that of *Pitymys* which it resembles in its reduced ear and tail, as well as in the unusually russet to tawny coloring.

Specimens examined.—Fourteen, from one hundred miles northeast of Peiping.

386. *Microtus mandarinus johannes* Thomas

Microtus mandarinus Thomas, Proc. Zool. Soc. London, for 1908, p. 976, 1909.

Microtus johannes Thomas, Abstract Proc. Zool. Soc. London, April 26, 1910, p. 26; Proc. Zool. Soc. London, 1910, p. 637.

Microtus (Phaiomys) mandarinus johannes A. B. Howell, Proc. U. S. Nat. Mus., vol. 75, art. 1, p. 52, 1929.

Type specimen.—An adult male, skin and skull, No. 9.1.1.178, British Museum, from twelve miles northwest of Kolanchow, Shansi, China, 7,000 feet. Collected June 5, 1908, by Malcolm P. Anderson.

Description.—A paler, buffier race, of slightly smaller size than the typical form. Color of the mid-dorsal area, from nose to base of tail, a nearly uniform pale "ochraceous buff," becoming clearer and more nearly "buff" on the sides. There is an almost complete absence of all-black hairs, the darkening of the back being due to the sprinkling of blackish-brown tips to many of the ochraceous-buff hairs. Upper and lower lips, the chin and remaining under surfaces have slaty- to gray-based hairs, tipped with pale buffy-white. On the chin and throat the short gray bases show through. Backs of the feet clad with whitish hairs. Tail buffy above, pure white below.

The last upper molar is very simple, consisting of a transverse space, an inner and an outer triangle of equal size, and a terminal Y-shaped lobe with a short heel in the line of the tooth row, and its outer arm much narrower than the inner, sometimes forming a small triangle, or again being hardly more than a ledge.

Measurements.—The following measurements were taken in the field by the collectors:

No.	Head and body	Tail	Hind foot	Ear	Locality
172585 USNM	88	22	15.5 (s. u.)	8	Shansi
172586 USNM	89	24	16.0 (s. u.)	7	Shansi
172587 USNM	98	24	16.0 (s. u.)	8	Shansi
172588 USNM	94	21	16.0 (s. u.)	8	Shansi
172589 USNM	95	23	16.0 (s. u.)	8	Shansi
9.1.1.178 BM (type)	95	23	17.0 (s. u.)	7	Shansi

For cranial measurements, see table under the typical race.

Occurrence and Habits.—This is a very strikingly marked race, of a nearly clear ochraceous buff above, reflecting the arid nature of the country in which it lives. According to the notes of Arthur de C. Sowerby, the range of mountains lying between Ningwufu and Taiyuanfu, Shansi, seems to constitute a barrier separating the range of this pale race of the borders of the Ordos Desert

from that of the darker races to the eastward. No doubt climatic and soil factors also characterize the areas to the east and west of this range. It is an inhabitant of open country, and like the other subspecies a great burrower, throwing out conspicuous heaps of earth from its burrows. The type locality is twelve miles northwest of Kolanchow, Shansi, within less than fifty miles from the place where Sowerby obtained a series for the U. S. National Museum—Wutsai, twenty miles west of Ningwufu. No other localities are known, but probably the range extends in northwestern Shansi as far as favorable conditions for grasslands occur toward the Ordos Desert.

Specimens examined:—Eleven as follows:

Shansi: Wutsai, twenty miles west of Ningwufu, 5 (U.S.N.M.); northwest of Kolanchow, 6 (B.M.).

387. *Microtus brandtii* (Radde)

YELLOW VOLE; BRANDT'S FIELD VOLE

Arvicola brandtii Radde, Mélanges Biol., Acad. Sci., St. Pétersbourg, vol. 3, p. 683, 1861.

Microtus brandti Miller, North Amer. Fauna, no. 12, p. 58, 1896 (in subgenus *Phaiomys*).

Microtus warringtoni Miller, Smithsonian Misc. Coll., vol. 60, no. 28, p. 1, pl. 1, 1913. Tabool, Mongolia.

Microtus (Lasiopodomys) brandti G. M. Allen, Amer. Mus. Novitates, no. 133, p. 7, 1924.

Microtus (Phaiomys) brandti A. B. Howell, Proc. U. S. Nat. Mus., vol. 75, art. 1, p. 53, 1929.

Type specimen:—The original specimens were taken by Radde in the course of his explorations in the northeastern part of Mongolia near Tarei Nor. They are presumably in the collection of the Academy of Sciences at Lenin-grad. No one specimen is specifically mentioned as the type.

Description:—The coloration of this species is quite distinctive, but although sometimes described as "yellow" is really sand-color, a pale buff sparsely and evenly lined with long black hairs. The greater part of the pelage therefore consists of hairs with dark slaty bases and pale buffy tips. Around the eye the color becomes brighter, pale ochraceous, forming a well-marked ring. At the sides and below the ears the black hairs are absent, giving a clear buffy tint. Backs of the feet pale whitish buff; tail about one and a third times the length of the hind foot, pale buffy all around. Under surface everywhere with the bases of the hairs bluish gray tipped with white. Upper and lower lips white.

The skull is rather stoutly built and angular in the adult, with wide zygomata, slender rostrum, prominent lambdoid crests, and slightly enlarged mastoid region. When adult, there is a prominent median bony crest in the interorbital region, continuing back nearly to the border of the parietals, where it joins the lateral ridges marking the upper borders of the big temporal muscles, leaving the summit of the brain case as a nearly quadrilateral flat area. The palate is of the "normal" *Microtus* type. The upper molars show no

special peculiarities: the first has the usual transverse space followed by four alternating triangles, all closed, two inner and two outer, making three salients on each side; the second tooth is similar but as usual with one less inner triangle, making two inner and three outer projections; the last upper molar is normal, consisting of the transverse prism, then an outer and an inner closed triangle, followed by a terminal Y-shaped lobe in which the outer anterior fork is slightly smaller than the inner and more set off by a constriction at its base. The first lower molar has usually four closed triangles in front of the posterior transverse prism, with the fifth triangle minutely open into the squarish lobe forming the front of the tooth. The second lower molar consists of a transverse prism posteriorly, with, in front of it, two inner and two outer alternating triangles, all practically closed. The last lower molar consists of three transverse lobes, of which the anteriormost has no external projection.

Measurements.—The following measurements of adults were taken by the collector from the fresh specimens:

No.	Head and body	Tail	Hind foot	Ear	Locality
57568	115	24	19	11	Mongolia
57578	130	27	20	10	Mongolia
57599	135	31	18	10	Mongolia
57604	123	26	19	10	Mongolia
57618	110	30	20	11	Mongolia

CRANIAL MEASUREMENTS OF *MICROTUS BRANDTII*

No.	Greatest length	Basal length	Palatal length	Zygomastic width	Mastoid width	Width outside molars	Upper cheek teeth	Lower cheek teeth	Locality
57568	27.9	26.0	15.6	16.5	14.1	5.7	6.6	6.3	Mongolia
57578	28.5	27.0	16.6	16.8	14.1	5.5	6.8	6.5	Mongolia
57699	29.0	27.1	16.5	17.0	14.5	5.6	6.8	6.4	Mongolia
57604	27.6	25.8	15.7	16.4	13.8	5.5	6.6	6.3	Mongolia
57618	26.9	25.2	15.2	16.3	13.4	5.5	6.2	6.5	Mongolia

Occurrence and Habits.—This is a vole of open, desert country, easily recognized by its sandy, buffy coloring. Although Hinton (1926) considers it entitled to separate generic rank as *Lasiopodomys* of Lataste, 1887, of which it is the type species, there do not seem to be any very well-marked structural characters to differentiate it from the *M. mandarinus* group, except that there are four or five instead of three closed triangles in the first lower molar. In its short tail and ears and well-haired sole it resembles *M. mandarinus*, but of course differs in color, size and other characters. I have therefore followed Miller (1896) and A. B. Howell (1929) in retaining it in the subgenus *Phaiomys*. It now appears, however, that *Microtus warringtoni* Miller, supposed to be distinct from typical *M. brandtii* on the basis of larger size, is really the same.

The type came from Tabool, near the northern edge of the Mongolian grasslands. These form the home of the animal quite across to the northern edge of the Gobi, whence at Tarei Nor came Radde's types. Westward as well as quite across the plateau from Tabool to Urga and west to Tsetsen Wang, Dr. R. C. Andrews found this a characteristic species. He supplies the following notes. "This very light-colored vole is found in colonies with the characteristic runways connecting the holes. At Tze Tzen Wang's this vole was the most abundant mammal I have ever seen. The plain was literally alive with them, and their burrows, connected by tiny paths, were everywhere. There were actually millions. When one walked over the ground one could hear their high-pitched chirpings like crickets on every hand. They appear to be almost entirely diurnal or certainly more so than nocturnal for our traps contained more in the day than in the night and we could see them at any time of the morning or afternoon. Whether they have driven out the other species of small mammals I do not know, but everything else was very rare. We caught in our hands a dozen or more young of varying ages. At our camp forty miles southwest of Tze Tzen Wang's, there was more gravel and this *Microtus* was not abundant, but a little farther on where there was less gravel and softer earth we saw them in great colonies and at the Ongin River there were millions of them. At Sain Noin Khan they were less abundant but still plentiful . . . on the grassy hillsides opposite the forest. At our Terelche Camp in a forested side valley, the main valley had grass-covered hills where we found a large colony of *Citellus*. Here this yellow vole was living in the patches of long grass among the 'gopher' holes. We never got it among the trees but always on the open grassy hillsides." Sowerby also attests to the diurnal habits of this species, for it was found about Tabool in open country only, "where it lives in holes in the walls of the camps and huts; at least it was only around buildings that I could catch any." It seems likely that in 1922, the year when Dr. Andrews found the animal so abundant in Mongolia, the species had reached one of the peaks of periodic abundance which various microtines seem to undergo. It was common also across the tableland on the road to Urga in 1919, when Dr. Andrews also secured a series, including a number of young ones, in late June. In 1922, many young, some certainly less than two weeks old, were taken May 25 at Tsetsen Wang. Kazanski (1930) has published (in Russian with English summary) an account of the work of a commission appointed by the People's Commissariat of Agriculture of the Buriat-Mongol Republic to investigate the regions of mass breeding of this vole in Mongolia and make experiments for its control. He writes that it breeds in immense numbers in eastern Mongolia, occupying an area of over 500,000 hectares with a density of from 1,000 to 3,000 voles per hectare, stretching in continuous colonies for scores of kilometers. "Seven districts of Tsetze-Khon province have been invaded by such colonies

and the resulting losses caused by the vole to cattle-rearers, are disastrous" on account of the destruction of vegetation, so that the cattle, deprived of their food supply, perish in numbers in the winter. He attests to the diurnal habits of this vole, saying that they "spend all the day on the surface of the ground and hide in their holes only after sunset. They are daring, active little animals" often running several meters from their burrows, carrying blades of grass, or chasing one another. In feeding they hold the grass in the fore paws. From the first of September they begin laying up a store of food for winter use, spending "the whole day long uninterruptedly rooting the vegetation, which they carry into the larders of their burrows," to the amount of from 2-5 kilos in each burrow. There appear to be two broods of young. None were found in August and September, but they were present in early July. There was some evidence that migratory movements took place, perhaps representing the overpopulation of certain areas. Experiments with various poisoned baits, using bits of bread as the bait, resulted in about sixty per cent mortality. Poisoned wheat and often the bread was thrown out from the burrows. Attempts at inoculation with bacterial disease proved relatively much less effective. According to the experiments of Wu Lien-teh (1930), this mouse is susceptible to plague.

Specimens examined:—In all, one hundred and two, as follows:

Mongolia: distances of from eighty to one hundred and forty miles southeast of Urga, 21; Tsetsen Wang, 40; thirty miles northeast of Tsetsen Wang, 15; forty miles southwest of Tsetsen Wang, 8; Hurumtu, 15; Sainnoin Khan, 1; Ongin River, 2.

Genus *Lagurus* Gloger

Lagurus Gloger, Hand- u. Hilfsbuch Naturgesch., p. 97, 1841 (as a genus). Merriam, Amer. Naturalist, vol. 29, p. 758, 1895 (as a subgenus). Miller, North Amer. Fauna, no. 12, p. 49, 1896 (as a subgenus). Hinton, Monogr. of Voles and Lemmings, vol. 1, p. 68, text fig. 42, 1926 (as a genus). *Eremiomys* Poliakov, Mém. Acad. Imp. Sci. St. Pétersbourg, (8^{vo}), vol. 39, suppl., p. 34, 1881.

Although treated as a subgenus by Miller (1896) in his review of the groups of voles and lemmings, Hinton (1926) considers this a full genus, and perhaps its many peculiarities entitle it to that rank from the modern standpoint. While resembling *Microtus* in the general structure of the palate and teeth, it offers a number of divergent characters. In external form, the tail is short—in the Old World species a mere stump—proportionately, as the name implies, almost as in a rabbit; the ears are very small and nearly hidden in the fur; the palms and soles are thickly hairy; the claws strong but not elongated. The mammae are eight as in *Microtus*. The skull is remarkable for the large size of the bullae which project out behind the plane of the supraoccipital to the level of the condyles and laterally to the width of the zygomata. The inter-orbital space is marked by two rounded ridges, with a narrow gutter between.

The postorbital projections of the squamosals are almost as peg-like as in the lemmings, and the well-marked temporal ridges converge backward to the lateral edges of the narrow interparietal. In ventral view the incisive foramina are slit-like, and the termination of the palate, though provided with the bony bridge of typical *Microtus* joining the anterior edges of the interpterygoid fossa, differs in that the lateral pits are very much more nearly on the palatal level. The tooth pattern is characterized by the great width of the reëntrant angles, giving each tooth a somewhat drawn-out appearance. The first and second upper molars consist of the usual transverse enamel space followed by four and three alternating closed triangles respectively, but with this difference, that on the inner side of the second triangle in the first tooth and the first triangle in the second tooth, the enamel wall is bent in to make a distinct obtuse angle. In the third upper molar there are three shallow outer folds and but two on the inner side of the tooth, but these latter are so deep and broad that they cut off almost completely two outer small triangles and an inner one, behind which the tooth ends in a long heel. The first lower molar has five closed triangles in front of the posterior transverse space, and a simple, rounded lobe in front, making four inner and five outer projections. The last two lower molars are alike in structure and primitive in pattern, each consisting of a posterior transverse prism, in front of which are four alternating and practically closed triangles, two inner and two outer. This condition of the molar teeth is unlike that of any other group of microtines.

The type species is Gloger's *Lagurus migratorius* which, according to Miller (1896), is probably a synonym of Eversmann's *Microtus* (= *Lagurus*) *luteus* rather than of *Lagurus lagurus* (Pallas). But a single species is as yet known from Mongolia, a desert-living, pale-colored animal. The group occurs in the Old World in the arid regions of central Asia, and reappears in somewhat less specialized condition in western North America.

388. *Lagurus przewalskii* (Buechner)

Eremiomys przewalskii Buechner, Wiss. Resultate d. v. Przewalski Reisen, vol. 1, Säugethiere, p. 127, pl. 12, figs. 1-2; pl. 13, figs. 1-9, 1889.

Lagurus przewalskii G. M. Allen, Amer. Mus. Novitates, no. 133, p. 11, 1924.

Type specimens.—The author designated no one of the series from which he described this species as the type, hence all are cotypes. Seventeen individuals are listed, young and old, Nos. 1912, 2303-05, 2251, 2070-76, 2079, with others not numbered. They were collected by Count Przewalski in part on the shore of Iche-zaidemin Nor in northern Tsaidam, 1879, and in part in Gass, south of Lob Nor, Sinkiang, central Asia, in 1884. The specimens are presumably in the Zoological Museum of the Academy of Sciences at Leningrad.

Description.—A pale-yellowish mouse with very small ears, minute stumpy

tail, and well-clawed feet with hairy soles. The head and body above are a uniform pale sandy buff, sparingly lined with scattered black hairs. On the sides the latter are absent and the coloring becomes pure buff. Bases of the hairs everywhere dark slaty. Backs of the feet white, their middle portion washed with buffy. The short tail is buff above, white below. Entire under surface of body and limbs, including the thick hair on the palms and soles, pure white, the bases of the hairs on chest and belly narrowly blue gray. Vibrissæ rather long, some white, some blackish brown. In some specimens a faint narrow dark line is evident in the midline of the back, due to concentration of black hairs.

The chief points of interest in the skull have already been described in the account of the generic characters.

Measurements:—The following measurements were taken in the flesh by the collector:

No.	Head and body	Tail	Hind foot	Ear	Locality
57854	125	14	20	—	Mongolia
57860	133	11	19	—	Mongolia
59827	130	15	22	7	Mongolia

CRANIAL MEASUREMENTS OF *LAGURUS PRZEWALSKII*

No.	Greatest length	Basal length	Palatal length	Zygomastic width	Mastoid width	Width outside molars	Upper cheek teeth	Lower cheek teeth	Locality
57854	31.5	29.0	17.5	18.0	18.6	5.8	6.8	6.8	Mongolia
57860	33.1	31.5	18.7	20.4	19.5	6.4	7.6	7.6	Mongolia

Occurrence and Habits:—Although taken at distances of eight hundred miles or more from the type locality, the series secured by Dr. Andrews's expeditions at various points in the Gobi does not seem to differ from those described by Buechner, so far as can be told from a comparison of his excellent description and figures. The range is therefore the sandy deserts of central Asia from Tsaidam, Chinghai, into the western and central parts of the Gobi. Here it seems to have been found in small numbers only, for but twelve specimens were taken in all, at Tsagan Nor, Loh, Uskuk, and Artsa Bogdo, and as far east as Iren Dabasu. They are apparently the first to be discovered in the Gobi and extend the known range of the species nearly a thousand miles to the eastward. According to Buechner, the animal was found in numbers by Przewalski about Iche-zaidemin Nor in northern Tsaidam, making shallow burrows in marshy spots. Later he obtained it south of Lob Nor, where its tunnels were found in the yellow sandy soil. It is apparently to some extent diurnal, for he described it as being shy, and when once frightened, waiting a long time before popping its head out from the burrow for a cautious look

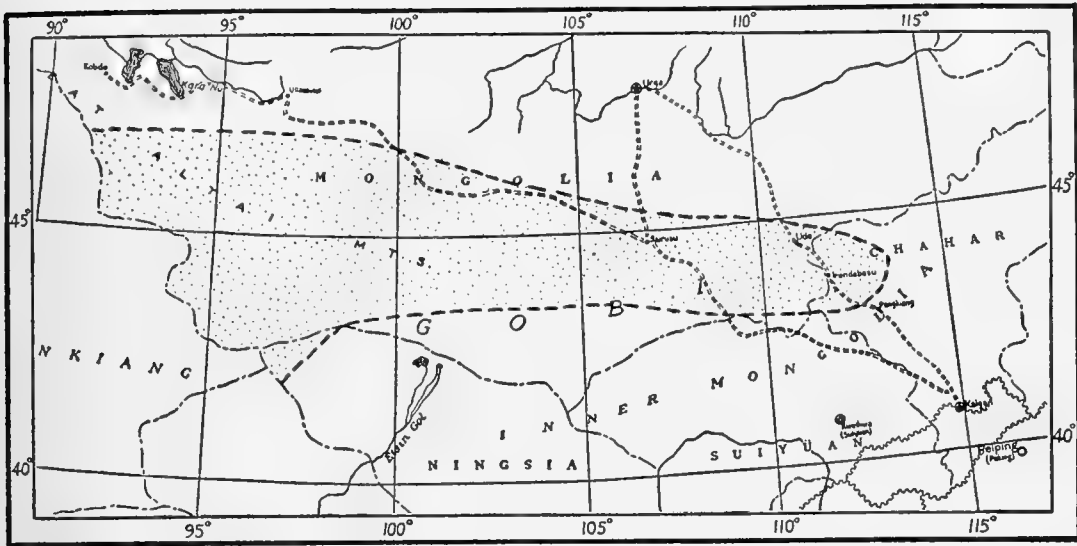


FIG. 40. Distribution Map.
Lagurus przewalskii

around. The reduced ears, stout claws, shortened tail, and the densely haired soles, with the fringes of stiff hair on the outer side of the feet, are all modifications for burrowing in sandy soil. Przewalski found stores of food laid up as if for winter use in burrows opened late in the year. The only plant identified in these stores was the desert-living *Sphaerophyza salsola*.

The relationships of this interesting rodent are obviously with *Lagurus luteus* (Eversmann), a species of the Aral Sea region of Turkestan. It is, however, a much paler and larger animal. Although the two are at present regarded as representing two distinct species, it seems likely that when the intermediate region is better known, it will be found that *L. przewalskii* grades into *L. luteus* and should stand as a subspecies of it.

Specimens examined:—In all, twelve, as follows:

Mongolia: Loh, 4; Erhlien (= Iren Dabasu), 1; Uskuk, 1; Tsagan Nor, 4; Artsa Bogdo, 2.

Genus *Ellobius* G. Fischer

Ellobius G. Fischer, *Zoognosia*, vol. 3, pp. 72-77, 1814. Hinton, *Monogr. of Voles and Lemmings*, vol. 1, pp. 81-88, text figs. 53, 54, 56, 1926.

Of all the genera of the Microtinæ, this is the most highly specialized for a fossorial and subterranean life. Exteriorly the fur is soft, of even depth, lacking stronger guard hairs, so that the pelage is plush-like as in other mammals that spend most of their lives in underground burrows. The ears are reduced to a low rim about the aural opening, and the tail is a mere projection. The feet are weakly clawed, for these mice do not dig with their claws, but use the enlarged and forwardly directed incisors for loosening earth as well as for cutting

the roots of vegetation on which they live. The feet are shaped somewhat as in the South African mole-rats, with the first digit of the fore foot very small, though with a distinct nail, the third digit longest, the fourth and fifth successively shorter. In the hind foot the fifth digit is very small, the three middle toes long and nearly of equal length. The skull is much modified over the usual microtine type. It is stoutly built, with heavy, wide-spreading zygomatica, short, slender snout, and wide, pear-shaped brain case. The postorbital projections on the squamosal bones are very slight, and the plane of the occiput is inclined a very little posteriorly from the vertex. The temporal muscles extend just beyond the outer edges of the parietals, making an indistinct ridge on each side. The palate is of a modified microtine type, with a short, double bony projection from its hinder edge in the rear of the nearly vertical bony bridge from the floor of the palate to the front of the lateral pits. These latter

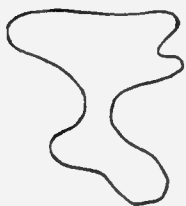


FIG. 41. *Ellobius tancrei*, outline of last upper molar (from No. 12.4.1.130, British Museum). Chagan Gol valley, Great Altai. Much enlarged.

are wide anteriorly and extend forward to the middle of the second molar. In correlation with its method of digging, the white incisors project beyond the closed lips. Their ever-growing roots extend so far back with a shallow curve that in the upper jaw they reach the center of the palate on a level with the back of the first molar, where in some specimens the root capsule resorbs the bone of the palate. In the lower jaw the incisor roots are correspondingly long, passing well below the last molar without displacing its capsule, then crossing to the outer side of the tooth, and ending in a rounded projection just external to the tip of the condyle, and on nearly the same level. The molars develop roots in the adult stage. Their enamel pattern is considerably modified from the usual microtine type, with the reëntnants nearly opposite and wide, yet so shallow that they cut off no triangular prisms. The first two upper molars have each two such indentations on each side, the last molar but one. In the lower jaw there are similarly no completely closed triangles. The first lower molar has a posterior closed transverse space, in front of which are three inner projections, long, narrow and triangular, while on the outer side there is but one short projection in addition to the outer hook of the anterior space. The second lower molar has its posterior transverse space, with in front of it two inner and two outer triangles, those of opposite sides widely confluent at the base, forming lozenge-shaped prisms. The last lower molar is structurally similar, but the posterior pair of triangles is not quite opposite; the outer is slightly the smaller and in advance of the inner, while in the anterior pair, the outer one is much reduced. The mammæ are two pairs pectoral and two pairs abdominal as in *Microtus*, and the number of sole pads is six on the hind foot as in that genus.

As a genus these burrowing rodents are found in desert country from southeastern Russia and the Caucasus region eastward to Afghanistan, southern Siberia and thence farther east into the Gobi. Although various forms have been described, it is likely that all or most of them are but local races of a single widespread species, *E. talpinus* (genotype, southern U. S. S. R.). Probably their requirements tend to segregate them in more or less localized colonies, each of which may be expected to develop slight characteristic differences just as do the colonies of American gophers. The following have been described from the area under consideration.

KEY TO THE MONGOLIAN SPECIES OF *Ellobius*

- A. Size larger, skull length including incisors, 31-34 mm. *E. talpinus larvatus*
 B. Size smaller, skull length of adults less than 29 mm. *E. talpinus orientalis*

389. *Ellobius talpinus larvatus* G. M. Allen

Ellobius larvatus G. M. Allen, Amer. Mus. Novitates, no. 133, p. 11, 1924.

Type specimen.—An adult male, skin and skull, No. 57886, American Museum of Natural History, from Artsa Bogdo, Mongolia, altitude 6,500 feet. Collected August 21, 1922, by the Central Asiatic Expeditions under Dr. Roy Chapman Andrews.

Description.—The coloration seems to be subject to more or less variation in tint on the back and in the amount of blackish on the face, dependent in part probably on age, but not altogether so. In the series examined, at all events, two styles of coloring are present. In the paler phase the forehead from the muzzle to a little beyond and below the eyes is brownish black, more or less minutely tipped with buff, while the entire remaining parts of the dorsal surface are very light sandy, about "pinkish buff," paling along the sides and gradually merging into the whitish-tipped hairs of the belly. The bases of the fur everywhere are slaty, darker above than below. Backs of the feet and their fringe of stiff hairs white. Tail buffy with a few darker hairs. In the brighter phase the color of the dorsal surface is much clearer, a uniform clear "pinkish cinnamon."

The chief characters of the skull have been described under the generic account. The enamel pattern of the molars is subject to more or less variation as well. The first upper molar consists of an anterior transverse space succeeded by four enamel angles, two outer and two inner, the latter very slightly in advance of the former, so that, instead of forming the usual four closed and alternating triangles, they make two rather lozenge-shaped transverse prisms. The tooth has three inner and three outer salient angles, and so is nearly bilaterally symmetrical. The second upper molar is similar but has the anterior transverse space represented by the outer half only, behind which there are a

single inner and two outer projecting angles, all confluent. The third upper molar may vary considerably in the enamel outline. In the simplest condition it consists of an anterior and a posterior transverse prism, connected by a narrow waist formed by the nearly equal inner and outer reëntrants which are opposite and arched instead of angular. In some cases the posterior space is a narrow lobe, but usually it is only slightly narrower than the anterior, and with lateral angles. The first lower molar has the usual posterior transverse space, in front of which are one outer triangle and two inner ones, all open at their bases, then an anterior trefoil which is rounded with the lateral wings very slightly indicated, making in all three outer and four inner salients. The reëntrants are of nearly equal depth on both sides and broadly rounded at their inner end. The second lower molar is nearly bilaterally symmetrical, with a posterior transverse prism, in front of which are two inner and two outer triangles, each pair opposite, forming two lozenge-shaped spaces, with the reëntrants nearly of equal depth on either side. The last lower molar is similar but much smaller, with its posterior lobe more nearly circular in outline instead of transverse.

Measurements:—The following measurements were taken from fresh specimens in the field:

No.	Head and body	Tail	Hind foot	Ear	Locality
57883	110	10	24	—	Mongolia
57885	108	12	24	—	Mongolia
59800	121	15	24	—	Mongolia
59801	125	18	24	—	Mongolia
59804	115	14	23	—	Mongolia
59816	106	12	20	—	Mongolia
59817	102	14	22	—	Mongolia
59823	124	15	24	—	Mongolia
57886 (type)	105	11	23	—	Mongolia

CRANIAL MEASUREMENTS OF *ELLOBIUS*

No.	Greatest length	Basal length	Palatal length	Zygomastic width	Mastoid width	Width outside molars	Upper cheek teeth	Lower cheek teeth	Locality
<i>E. talpinus larvatus</i>									
59805	33.0	29.0	19.6	21.5	15.0	7.6	7.6	7.6	Mongolia
59795	32.0	29.0	19.0	21.0	14.5	7.6	8.0	7.5	Mongolia
59806	32.1	28.5	19.5	21.5	14.6	7.6	8.0	7.5	Mongolia
59804	31.5	28.0	18.2	20.5	14.7	7.2	7.4	7.0	Mongolia
59808	31.5	28.0	18.0	21.0	14.0	7.4	7.4	7.7	Mongolia
59799	33.0	29.6	19.5	21.7	14.8	7.0	7.2	7.5	Mongolia
59800	33.5	29.5	19.5	22.1	14.8	7.0	7.4	7.3	Mongolia
59801	33.3	29.3	20.0	22.3	15.0	7.0	7.2	7.7	Mongolia
59796	34.0	30.0	19.5	21.5	15.0	6.8	7.0	7.2	Mongolia
57886 (type)	32.0	29.8	18.0	21.0	14.0	—	8.0	7.5	Mongolia

CRANIAL MEASUREMENTS OF *ELLOBIUS* (Cont'd)

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width outside molars	Upper cheek teeth	Lower cheek teeth	Locality
<i>E. talpinus orientalis</i>									
57893 (type)	28.5	26.5	16.0	19.0	13.0	—	6.4	6.8	Mongolia
57890	28.5	27.1	17.0	18.9	13.1	6.2	6.5	6.5	Mongolia

The males and females do not differ in size.

Occurrence and Habits:—No doubt this pale race is close to *E. tancrei* of the Altai, and may even prove to be inseparable from it when better series are available from the Altai region. So far as present evidence goes, however, it seems to be smaller and paler than either that race or *E. albicatus* of Chinese Turke-

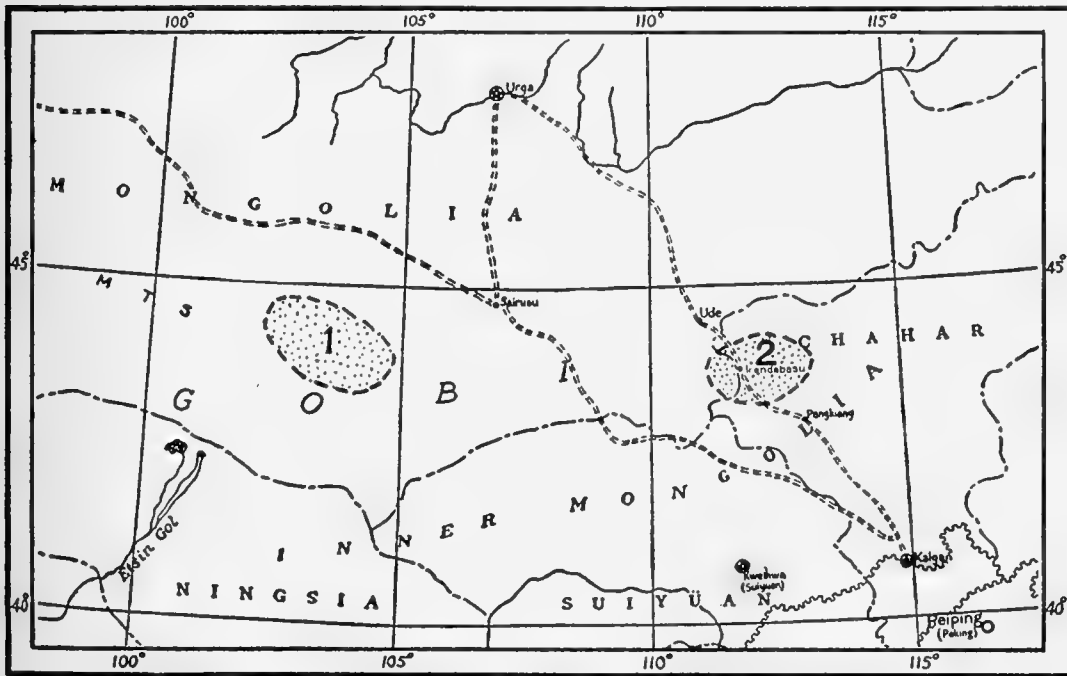


FIG. 42. Distribution Map.
Ellobius

1. *E. talpinus larvatus*

2. *E. talpinus orientalis*

stan, without so clear deep-black a facial mask. *E. cænosus* of the Tien Shan is larger and darker, with squared instead of strap-shaped interparietal, and with a buffy belly. Perhaps, too, *E. fusciceps* and its supposed dark subspecies *E. f. ursulus* of northwestern Dzungaria are not very different.

The discovery of this burrowing microtine in the central Gobi by the Central Asiatic Expeditions was a considerable extension eastward of the known range of the genus. A series was secured at Artsa Bogdo in 1922, where the

burrows were found high up on the mountain slopes, and from the Oshih basin, some twenty miles north of that locality, in the following summer. It must be rather local in its distribution, for Dr. Andrews did not meet with it elsewhere.

There is in the British Museum an old and much discolored specimen of *Ellobius*, labeled merely "China." It was received many years ago from Brandt, but the exact locality is unknown.

Specimens examined:—In all, forty-three, as follows:

Mongolia: Artsa Bogdo, 25; Oshih basin, twenty miles north of Artsa Bogdo, 18.

390. *Ellobius talpinus orientalis* G. M. Allen

Ellobius orientalis G. M. Allen, Amer. Mus. Novitates, no. 133, p. 12, 1924.

Type specimen:—An adult male, skin and skull, No. 57893, American Museum of Natural History, from Iren Dabasu, eastern Mongolia. Collected April 25, 1922, by the Central Asiatic Expeditions under Dr. Roy C. Andrews.

Description:—Smallest of the eastern races of the genus, as well as the most eastern, this subspecies does not appear to differ in color characters, but in the few specimens available is closely like the cinnamon phase of *E. t. larvatus*. The type has the facial patch well developed, covering the muzzle from the nose to the forehead nearly to the level of the ears, and including the lower eyelids, about "fuscous" in color. The rest of the dorsal surface and the face below the level of the eyes, and the upper arm are uniform clear "pinkish cinnamon" (Ridgway). The flanks are dull white. The tail tuft is like the back, above, and nearly the same below. Ventral surfaces with the gray bases of the hairs everywhere showing through the whitish tipping. Backs of the feet silvery white.

The skull is much smaller, with shorter tooth rows and smaller teeth than in the more western *E. t. larvatus*. The skull of the type and of a second specimen from the same locality are fully adult, with the basal suture closed and ridged, the sides of the brain case with well-developed muscle scars, so that there can be no question of youth, yet the measurements are all strikingly smaller, both of the skull and of the hind feet. From immature specimens of *E. t. larvatus* it is distinguishable not only by the appearance of the skull, but almost always by the relation of the following bones: in *E. t. orientalis* the posterior extension of the nasals reaches back to the same level as the ends of the premaxillaries, while in the zygomatic arch the maxillary process joins the squamosal process beneath the jugal; whereas in *E. t. larvatus* the nasals in almost every case do not reach the posterior level of the ascending branch of the premaxillary, and in the zygomatic arch the jugal intervenes even if for only a short distance between the maxillary and the squamosal processes.

Measurements:—The collector's measurements of the type and three topotypes are as follows:

No.	Head and body	Tail	Hind foot	Locality
57890	100	9	20	Mongolia
57891	95	9	19	Mongolia
57892	95	8	19	Mongolia
57893	108	10	21	Mongolia

For cranial measurements, see table under *E. t. larvatus*.

Occurrence and Habits.—This more eastern race is represented by four specimens, all from Iren Dabasu in eastern Mongolia. These agree in that fully adult animals are smaller of skull and tooth, and the hind foot is some three or four millimeters shorter than in *E. t. larvatus*. The specimens at hand are all in the cinnamon phase, possibly a trifle paler than in *E. t. larvatus*. Presumably the range of this animal is influenced by factors of the terrain not yet made clear. It is eminently fitted for a subterranean life. Indeed, Dr. Andrews writes that it lives wholly underground, and that specimens were secured by digging open their tunnels. The small heaps of earth thrown out by the animals in burrowing give the only indication of their presence.

Specimens examined.—Four, all from the type locality, Iren Dabasu, Mongolia.

Genus *Proedromys* Thomas

Proedromys Thomas, Abstract Proc. Zool. Soc. London, February 14, 1911, p. 4; Proc. Zool. Soc. London, 1911, p. 177. Hinton, Monogr. of Voles and Lemmings, vol. 1, p. 60, text fig. 33 (enamel pattern), 1926.

This peculiar genus of microtines is known at present from a single specimen only, that is remarkable in combining certain primitive characters of the teeth with others more progressive. In its external form it shows no special modifications, is of medium size, with the tail about a third the length of head and body, fur soft and fine. The sole-pads of the hind feet are the usual six, the mammæ two pairs pectoral, two pairs inguinal, or eight in all.

The skull is heavily built, its upper profile strongly curved, the postorbital squamosal projections strongly developed, almost peg-like. Posterior palate "normal," that is, of the usual form in typical *Microtus*, with a median bony ridge sloping upward from its hind margin to join the center of the lateral pits, instead of being a transverse shelf.

The upper incisors are broad, recurved and grooved, the lower incisors remarkably short, scarcely penetrating into the condylar process of the jaw, a primitive trait. The molars are rootless, tall-crowned and broad. The anterior upper tooth consists of the usual transverse space, followed by two outer and two inner alternating closed triangles, so that there are three angles on each side. The second upper molar has a transverse prism, followed by two outer triangles and one inner one, all closed, making three outer and two inner salients. The last upper molar is unusually simple in structure, consisting of

the anterior transverse prism, an outer and an inner closed triangle, and a terminal lobe that projects to the *outer* side, so that there are but three outer and two inner salient angles. The first lower molar is correspondingly reduced, having only four triangles, all closed, in front of the posterior transverse space, while the anterior lobe lacks an internal salient and so does not form a trefoil. The tooth has therefore five outer angles. The second lower molar has four alternate closed triangles and a posterior transverse prism, making three angles on each side, while the third molar has two transverse prisms behind the outer anterior triangle, making but two outer and three inner projections. The enamel pattern is figured by Hinton (1926, p. 60), from whose account and that of Thomas the above facts are taken.

The single species and type of the genus is *P. bedfordi* Thomas.

391. *Proedromys bedfordi* Thomas

DUKE OF BEDFORD'S VOLE

Proedromys bedfordi Thomas, Abstract Proc. Zool. Soc. London, February 14, 1911, p. 4; Proc. Zool. Soc. London, 1911, p. 177. Hinton, Monogr. of Voles and Lemmings, vol. 1, p. 60, text fig. 33, 1926.

Type specimen.—An adult female, skin and skull, No. 11.2.1.235, British Museum, from sixty miles southeast of Minchow, Kansu, China. Collected March 11, 1910, by Malcolm P. Anderson.

Description.—In outward appearance this is described as having the usual vole-like form but is very long-haired. The tail is "rather more than a third the length of the head and body." General color above "coarsely lined dull brown (darker than 'broccoli-brown'), the lower flanks more drabby; under surfaces slaty drab washed with brownish white" (Thomas). Feet dull white; tail bicolor, brown above, dull white below.

The characters of the skull and teeth are given under the generic description.

Measurements.—The dimensions of the type are: head and body, 103 mm.; tail, 41; hind foot, 18; ear, 13. Its skull measured: basal length, 26 mm.; greatest breadth (zygomatic), 16; nasals, 7.6 by 3.2; interorbital width, 3.6; breadth of brain case, 12.2; palatilar length, 13.7; diastema, 8; upper molars, crowns, 6.8 (from Thomas); width across molars, 5.6.

Occurrence and Habits.—Known hitherto only from the type specimen taken sixty miles southeast of Minchow, Kansu, this peculiar species is another of the remarkable mammals discovered in this corner of China in recent years. According to its describer, it closely resembles in outward appearance *Microtus malcolmi* found in the same region, or, as it seemed to me, *M. mandarinus*. The broad, grooved upper incisors and the simplified molar pattern, however, readily distinguish it. The claws are rather stout and the ears noticeably

small. It may eventually prove to be an abnormal individual of one of these species.

Specimens examined:—One, the type (B.M.).

Family PLATACANTHOMYIDÆ

SPINY DORMICE

The two genera of this family, *Platacanthomys* and *Typhlomys*, have usually been considered members of the dormouse group, family Muscardinidæ, but Miller and Gidley in their synopsis of the supergeneric groups of rodents (1918) regard the likenesses as parallelisms, and found a new family for the two groups in question. The family is characterized by the unusual "zygomasseteric structure," the infraorbital foramen being of the "normal cricetine form, but zygomatic plate much narrowed, and masseter lateralis profundus extending its line of attachment along upper zygomatic border to side of rostrum above foramen; cheekteeth subhypsodont." The enamel pattern of the molariform teeth tends to form oblique instead of transverse ridges. Only the genus *Typhlomys* is known to occur in China, while *Platacanthomys* is Indian.

Genus *Typhlomys* Milne-Edwards

Typhlomys Milne-Edwards, Bull. Soc. Philom. Paris, ser. 6, vol. 12, p. 9, (1875) 1877.

External form mouse-like, with prominent, nearly naked ears, and long tail exceeding the length of head and body, its basal half sparsely haired and scaly, its terminal portion more thickly clothed with longer hairs forming a distinct terminal brush. Fore feet without a definite thumb, although a large pad marks its place. Hind feet elongate, slender, the first toe barely reaching the base of the second, the claws of all slender and compressed. The skull, as stated by Miller and Gidley, is somewhat like that of the Cricetidæ, with the antorbital foramen enlarged above, with a forwardly extending groove for muscle attachment. The zygomatic plate is narrow with nearly parallel vertical borders. Two series of vacuities are present, making two lengthwise rows of from two to three pairs of holes in the palate, the anteriormost pair separated from those following by a slightly wider bony ridge. The teeth are: $i. \frac{1}{1}$ $c. \frac{0}{0}$ $pm. \frac{0}{0}$ $m. \frac{3}{3} = 16$, with therefore only three maxillary teeth in each side of each jaw. Of these the anteriormost is the largest, and in each of the two anterior teeth is a series of four external infoldings of enamel extending obliquely across the tooth in the upper jaw, with corresponding infoldings from the inner side in the lower teeth. These ridges in the last molar tend to be more nearly transverse.

There is but a single species known from China.

392. *Typhlomys cinereus cinereus* Milne-Edwards

Typhlomys cinereus Milne-Edwards, Bull. Soc. Philom. Paris, ser. 6, vol. 12, p. 9, (1875) 1877.

Type specimen.—The type specimen came from western Fukien and is presumably still in the Muséum d'Histoire Naturelle at Paris.

Description.—Size about that of a large house mouse, with short, close pelage, of a uniform deep mouse-gray above. In some specimens the lips and fore feet are white, but in others the upper lips are gray as well, and the fore as well as the hind feet and ears thinly clothed with very short dark-brown hairs. Entire ventral surface from chin to anus, and the inner side of the limbs to the wrists and to the knee, grayish, the hairs everywhere gray at base, tipped with white. The hind legs are gray all around at the ankles. The tail is longer than head and body, with rings of scales, between which grow out blackish-brown hairs, very short on the basal half but in the apical half forming a loose brush, and usually tipped with white.

The rather full brain case, slightly elevated profile, and slender rostrum combine to give a rather dormouse-like appearance, which, with the curious ribbed pattern of the molars, has led to its previous reference to the *Muscardinidæ*, but the characters of the antorbital foramen, the zygomata, and the reduction of the teeth to three instead of four as in that family seem to justify the separation of the genus, as Miller and Gidley have shown.

Measurements.—A fine series collected by Mr. Clifford H. Pope presents the following field measurements:

No.	Head and body	Tail	Hind foot	Ear	Locality
60332	89	109	20	16.0	Fukien
60334	82	99	19	15.0	Fukien
84761	77	111	19	16.0	Fukien
84762	71	101	20	16.0	Fukien
84764	72	94	20	14.0	Fukien
84765	70	106	20	16.0	Fukien
84767	75	—	19	15.5	Fukien

CRANIAL MEASUREMENTS OF *TYPHLOMYS*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
60332	23.1	19.6	11.5	12.8	10.5	5.3	3.6	3.7	Fukien
98.II.I.10 BM	21.7	17.9	10.3	11.5	9.8	5.0	3.5	3.7	Fukien
98.II.I.11 BM	22.4	19.1	10.6	11.6	9.6	5.1	3.5	3.5	Fukien
8.8.II.108 BM	22.6	—	9.8	12.5	10.5	5.2	3.4	3.6	Fukien
8.8.II.109 BM	22.7	19.3	11.0	—	10.4	5.3	3.4	3.8	Fukien

Occurrence and Habits:—This gray mouse-like creature with its long tufted tail is as remarkable in appearance as it is unmistakable. Hitherto it has been found in China only in the mountains of western Fukien, unless Cabrera (1922, p. 166) is correct in recording two specimens as from Foochow. Thomas in 1898 recorded six skins and a male in alcohol from Kuatun, and called attention to the fact that there is a distinct cæcum about an inch long present in the intestinal tract. La Touche, who obtained these specimens, says they are found in the mountains above the village at an elevation of about 4,000 feet. It was in this same region that P. D. Bergen secured a specimen for the American Museum in 1911, while more recently Mr. Clifford H. Pope obtained some ten additional specimens in the vicinity of Chunganhsien, close to Kuatun. He writes that the mountains here are wild and forested, rising to a height of perhaps 7,000 feet. The natives who brought in this series appear to understand trapping it, but nothing seems to be definitely in print as to its habits. The Chinese name for it is "chu-wei-hao-tze" or Pig-tailed Rat, and it is said that a cat cannot be persuaded to eat one.

The discovery of a larger subspecies, *T. c. chapensis* Osgood, in Tongking is interesting as throwing additional light on the distribution of the species.

Specimens examined:—The following twenty-two:

Fukien: Chunganhsien, 10; northwestern part, 1; Kuatun, 11 (B.M.).

Family RHIZOMYIDÆ

BAMBOO RATS

The rodents of this group were placed by Flower and Lydekker as a genus of the Spalacidæ or blind rats, but Miller and Gidley are undoubtedly justified in emphasizing their peculiarities by making them a separate family. The entire structure reflects their modification for a subterranean life, but is clearly myomorphine. The latter authors draw attention to the condition of the ant-orbital foramen as a predominant characteristic. Instead of having its long axis vertical and its general outline V-shaped, with a branch of the fifth nerve passing through the bottom of the trough thus formed, it is oval and its long axis transverse, with the larger end innermost. Its position is further peculiar in that it lies dorsal to the zygomatic plate, or as Miller and Gidley put it, the neural portion of the foramen is "reduced or obliterated by partial or entire fusion of zygomatic plate with side of rostrum."

Externally the changes incident to fossorial life include the reduction of the ears, which are hidden in the fur, though with well-developed rounded conch; the shortening of the tail to less than twice the length of the hind foot, and its scantiness of hair; the shortening of the limbs; and the soft dense nature

of the fur. The claws are short and slightly flattened, almost nail-like, apparently unsuitable for a burrowing habit, but possibly the stout incisor teeth supplement the feet in digging. The skull is large and triangular in outline, with strong, widely bowed zygomatic arches, a prominent sagittal crest, and high lambdoid crests, the latter bounding the broad and backward-sloping occipital plate for the attachment of the powerful neck muscles. The enamel pattern of the molariform teeth shows in the upper series two reëntrant folds from the outer, and one from the inner side in the two anterior teeth, and a second smaller infold on the inner side of the last or third tooth, with the reverse condition in the lower molars. Two subfamilies are recognized among the living members of this group: the Rhizomyinæ, which includes the Asiatic genera, and the Tachyoryctinæ of eastern Africa.

The old genus *Rhizomys* has now been subdivided into several coördinate genera, of which *Cannomys* and *Nyctocleptes* include species about the size of the American pocket gophers, *Geomys* and others, whose ecological niche they more or less occupy in southeastern Asia. So far as at present known, neither of these occurs in China, although one, represented by *Cannomys minor* (Gray), was recorded by Thomas (1915c) from Chiengmai and Nan, northern Siam, and the other, represented by *Nyctocleptes sumatrensis cinereus* (McClelland), is known from northern Tongking (Osgood, 1932), so that it seems quite likely that further search on the extreme southern borders of Yunnan will show the presence there of both genera. Anderson (1879) long ago recorded *Rhizomys* (now *Cannomys*) *badius castaneus* from the Kakhyen Hills on the Burma border of Yunnan, but "it does not appear to exist in the high, treeless region about Tengyueh-chow" across the border in Yunnan, where the country is covered "only with short grass and bracken." Nevertheless it may just reach parts of extreme southwestern Yunnan.

Genus *Rhizomys* Gray

Rhizomys Gray, Proc. Zool. Soc. London, August 5, 1831, p. 95. Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 16, p. 57, 1915.

The restricted genus *Rhizomys* differs from *Cannomys* and *Nyctocleptes* not only in the greater size of its members, but also, and perhaps because of the greater size, in having the upper incisors nearly vertical, their tips directed backward, instead of proclivous. The incisors are very broad and heavy and colored orange. The cheek teeth are three above and three below on each side, all regarded as true molars. They are rooted throughout life and have an enamel pattern formed by two outer and one inner reëntrant fold in the two anterior teeth, with a smaller posterior fold on the inner side in the third. Since these folds are of varying vertical extent, they become worn down with in-

creasing age to form different patterns, consisting of small isolated rings or ellipses of enamel within the enamel-bounded crown. In old age these quite disappear, and the crown is simply a nearly rectangular area, walled by enamel, and with a slightly concave surface. The anteriormost molar is the smallest, the middle one largest, with its crown and that of the last molar often on a distinctly higher plane (as seen from ventral aspect) than that of the first molar. The root of the lower incisor passes well below the last molar without displacing it, and crossing to the outer side of the jaw, forms a prominent protuberance just lateral to the condyle which it does not quite equal in height. The coronoid process is vertical and triangular, its tip exceeding the condyle in height by about the combined length of the first and second molars. Externally, in addition to the general characters previously mentioned, the pads of the feet are distinct and granulated, those of the hind foot six in number, the two posterior separate though close together and subcircular. The mammae are: one pair pectoral, three abdominal, or eight in number.

The genus as proposed by Gray contained two species, *Rhizomys sinensis* and *R. sumatrensis*. Since the latter is the type of the genus *Nyctocleptes*, the former becomes that of *Rhizomys*, as stated by Thomas (1915b).

Two species of the genus occur in China, each with subspecies, as indicated in the following key. They are chiefly southern in their distribution, not extending north of the Yangtze valley in eastern China, but in the western highlands one species ranges northward to Kansu. An excellent account of the general anatomy of the genus is given by J. Anderson (1879) with colored figures of the exterior of both this genus and of *Cannomys* (then regarded as identical generically).

KEY TO THE CHINESE SPECIES OF *Rhizomys*

- | | |
|--|------------------------------|
| A. Fur silky, brownish above..... | <i>R. sinensis</i> |
| a. Skull length about 65 mm. | |
| a'. Larger, posterior width of nasals equaling fronto-premaxillary suture..... | <i>R. sinensis sinensis</i> |
| b'. Smaller, posterior width of nasals equaling half the length of fronto-premaxillary suture..... | <i>R. sinensis davidi</i> |
| b. Skull length about 75 mm. | |
| a'. Color pinkish gray..... | <i>R. sinensis vestitus</i> |
| b'. Color darker, drabby gray..... | <i>R. sinensis wardi</i> |
| B. Fur slaty, with many white-tipped hairs..... | <i>R. pruinusus</i> |
| a. Teeth heavy, size smaller, condylobasal length about 67 mm.... | <i>R. pruinusus senex</i> |
| b. Larger, condylobasal length about 69 mm..... | <i>R. pruinusus latouchi</i> |

393. *Rhizomys sinensis sinensis* Gray

Rhizomys sinensis Gray, Proc. Zool. Soc. London, August 5, 1831, p. 95; Illustrations of Indian Zool., vol. 2, pl. 16, 1833-34.

Rhizomys chinensis Swinhoe, Proc. Zool. Soc. London, 1870, p. 637. Mell, Arch. f. Naturgesch., vol. 88, sect. A, no. 10, p. 22, 1922.

Type specimens.—There were two specimens upon which Gray based this species, skins with skulls, in the British Museum, sent from near Canton, Kwangtung, China, by the collector, John Reeves, in 1831. Both are cotypes; the lectotype is No. 116.1.6 (skull) and No. 49a (skin). One of these doubtless served as the subject of Gray's plate in the "Illustrations of Indian Zoology."

Description.—Anderson (1879, p. 330), who examined the types in the British Museum, described the color as follows: the fur, which is thick, dense and soft, is pure gray at the base, tipped with pale brownish, with a rich, shining lustre. "The brownish hue is most marked on the sides of the face below the ear, and on the front of the head, but in the younger example the area of the sides of the head and of the chin and throat to the sides of the muzzle is grey, approaching to white. The under parts are much the same as the upper. The claws of both feet are strong and olive-brown."

Measurements.—Anderson gives the measurements of what was doubtless the larger cotype, as follows: head and body, 9.30 inches (236.2 mm.); tail, 2.90 inches (73.6 mm.). No other measurements are available except those of the skull of the lectotype: greatest length, 65.8 mm.; basal length, 62.5; palatal length, 41.4; zygomatic width, 37.9; mastoid width, 30.5; width across molars, 16.5; upper cheek teeth, 15.8.

Occurrence and Habits.—Although the first specimens of this bamboo rat were secured over a century ago in the vicinity of Canton, Kwangtung, by John Reeves, no others of the typical race were collected by naturalists until R. Mell obtained specimens during the later years of the World War while he was in that province. He writes (Mell, 1922, p. 27) that he found them in the mountain bamboo forest of northern Kwangtung, and mentions specifically one from "Quellberg" (Spring Mountain). They apparently do not occur below 400 meters altitude, hence it is likely that Reeves's specimens were bought in the native market at Canton and did not actually come from the vicinity of that city. Mell adds that the species occurs on the mountains of the watershed between the North and East Rivers, Ling Shan and Mahutze Shan, in northern Kwangtung. Specimens had grass seeds in their stomachs and are said also to eat the fruit of *Erianthus japonicus*. No doubt their chief sustenance is, however, the roots and shoots of bamboo. Mell tells of finding

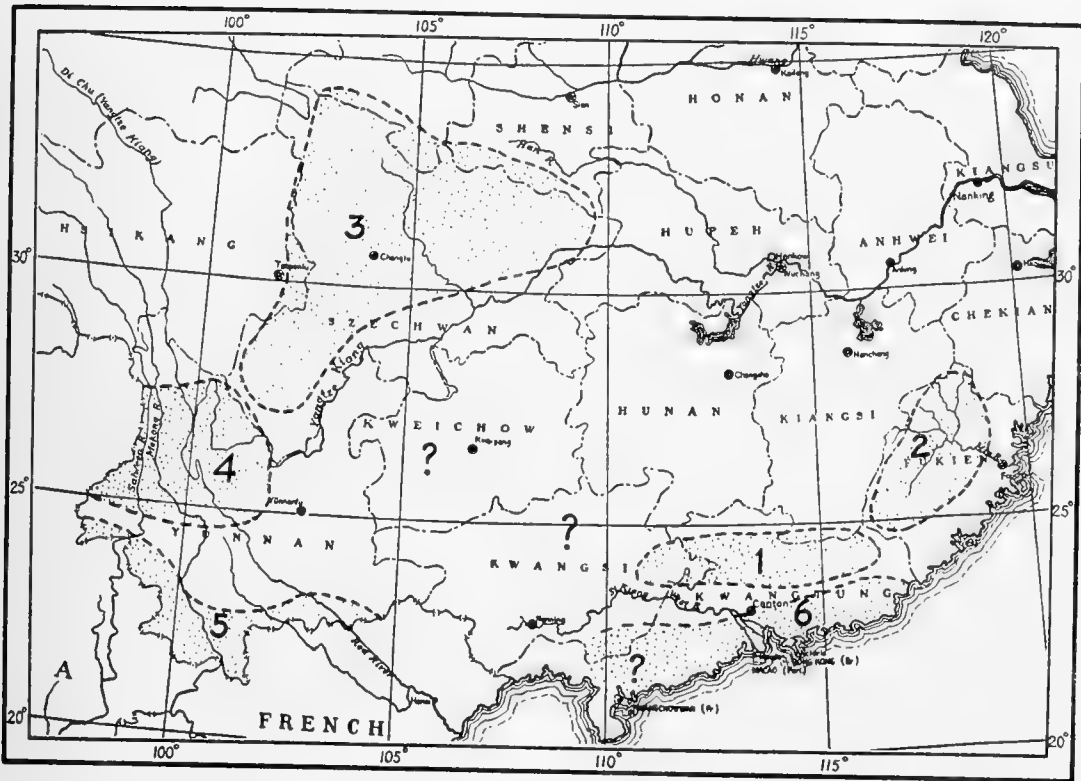


FIG. 43. Distribution Map.

Rhizomys

- | | | |
|--------------------------------|--------------------------------|----------------------------------|
| 1. <i>R. sinensis sinensis</i> | 3. <i>R. sinensis vestitus</i> | 5. <i>R. pruinosus senex</i> |
| 2. <i>R. sinensis davidi</i> | 4. <i>R. sinensis wardi</i> | 6. <i>R. pruinosus latouchei</i> |

three naked and blind nest young on December 31 in the mountains near Shutipai. Shih (1930, p. 9) has reported finding this species in the mountains of the Yao Shan region, central Kwangsi, in the districts of Loshiang and Kutchen. Very young ones were taken in June, July and November. The Chinese prefer their flesh to pork. Little information is available as to the habits of these rats, but it is said that they are more terrestrial than subterranean. As a species, *R. sinensis* appears to have a wide range, extending northeastward at least to the mountains of Fukien, and in the western highlands even farther northwestward to the borders of Kansu, dividing into several subspecies. Available evidence indicates that it is probably a mountain species, more or less dependent upon bamboo growth, and so largely restricted to the bamboo belt.

Specimens examined:—One, the lectotype, from near Canton, Kwangtung (B.M.).

394. *Rhizomys sinensis davidi* Thomas

Rhizomys sinensis Thomas, Proc. Zool. Soc. London, 1898, p. 775 (not of Gray). Cabrera, Bol. Real Soc. Esp. Hist. Nat., Madrid, vol. 22, p. 169, 1922.

Rhizomys davidi Thomas, Abstract Proc. Zool. Soc. London, February 14, 1911, p. 5; Proc. Zool. Soc. London, p. 179, 1911.

Type specimen.—An adult female, skin and skull, No. 96.12.1.6, British Museum, from Kuatun, northwestern Fukien, China. Collected in December, 1898, by J. D. La Touche.

Description.—This can be hardly more than a race of *R. sinensis*, which it resembles closely in external appearance, form and coloring, but is smaller, with a broader rostrum. The color is the same uniform grayish brown, scarcely lighter below, except on the chin where it is clearer gray.

The skull, according to Thomas, is slightly larger than that of *R. s. sinensis*, that of the male in the latter equaling that of the female in *R. s. davidi*. In the series of topotypes examined, however, there is no significant difference in the size of the sexes, as will appear in the table of measurements. The crests are said to be "rather more strongly developed" as well. The more obvious difference seems to be in the comparative width of the nasals and the adjacent portion of the premaxillaries, the former more narrowed behind and the latter proportionately wider, "so that, while in *R. sinensis* the combined breadth behind of the two nasals about equals either fronto-premaxillary suture, in *R. davidi* the length of each suture is about twice the distance that separates their nearest points in the middle line."

Measurements.—No flesh measurements have hitherto been available so the following, taken from the fresh specimens by the collectors, are of value.

No.	Head and body	Tail	Hind foot	Ear	Sex	Locality
60236	229	55	38	19.0	♂	Fukien
60237	216	50	35	15.0	♂	Fukien
84521	293	77	41	18.0	♂	Fukien
84523	296	75	41	19.0	♂	Fukien
84527	275	65	40	18.5	♂	Fukien
84533	280	85	44	20.0	♂	Fukien
84524	278	65	40	17.0	♀	Fukien
84534	261	80	40	15.0	♀	Fukien
84537	240	82	40	15.0	♀	Fukien
84538	280	78	45	17.0	♀	Fukien
84540	288	75	—	17.0	♀	Fukien
84541	277	62	42	15.0	♀	Fukien
84544	304	90	43	15.0	♀	Fukien

The measurement of head and body as given by Thomas from the prepared skin, 350 mm. (circa), seems therefore very large.

CRANIAL MEASUREMENTS OF *RHIZOMYS SINENSIS*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Sex	Locality
<i>R. sinensis sinensis</i>										
116.1.6 BM (type)	65.8	62.5	41.4	37.9	30.5	16.5	15.8	—	—	Canton
<i>R. sinensis davidi</i>										
84521	67.0	62.5	41.0	47.0	29.6	17.0	14.2	15.0	♂	Fukien
84523	67.0	65.0	44.0	51.0	32.8	16.5	15.8	14.5	♂	Fukien
84527	66.0	61.8	41.0	50.4	31.0	16.0	15.0	14.0	♂	Fukien
84531	63.5	60.3	39.5	47.5	31.3	16.0	14.0	14.0	♂	Fukien
84522	65.0	62.0	41.0	49.0	—	16.5	14.0	14.5	♀	Fukien
84524	65.0	62.0	41.0	50.0	31.0	16.8	15.0	13.0	♀	Fukien
84530	62.0	60.0	38.0	47.0	31.0	16.3	15.5	13.5	♀	Fukien
84534	63.0	59.5	39.5	46.5	30.0	16.0	14.5	13.8	♀	Fukien
84540	65.0	61.4	40.5	50.0	30.5	16.5	15.5	14.4	♀	Fukien
84544	65.0	61.5	41.5	49.0	32.0	16.2	14.6	14.0	♀	Fukien
92.12.1.6 BM (type)	64.5	62.0	40.4	49.4	34.2	16.2	15.8	—	—	Fukien
<i>R. sinensis vestitus</i>										
7560 MCZ	77.4	72.5	48.4	(58.5)	—	19.0	17.0	16.5	♂	Szechwan
15095 ANSP	87.0	81.8	55.5	66.3	44.6	20.5	18.0	17.6	♂	Szechwan
7561 MCZ	75.1	71.8	48.5	56.5	40.9	19.3	17.4	16.5	♀	Szechwan
7562 MCZ	75.1	71.7	47.7	59.0	41.2	19.3	16.7	15.4	♀	Szechwan
15093 ANSP	76.6	72.8	48.8	58.3	39.7	19.1	17.4	16.5	♂	Szechwan
15094 ANSP	76.5	74.8	50.3	61.0	40.5	20.2	18.8	17.6	♂	Szechwan
15096 ANSP	73.9	68.3	46.4	58.4	40.6	18.4	16.6	16.8	♀	Szechwan
9.7.2.8 BM	80.5	76.7	51.0	59.0	42.7	19.2	17.6	16.6	—	Szechwan
9.7.21.7 BM	76.7	73.1	48.7	58.6	40.8	19.1	16.7	17.0	♂	Szechwan
<i>R. sinensis wardi</i>										
28089 MCZ	66.0	61.8	41.6	49.3	31.8	17.0	17.3	17.5	Im.♂	Yunnan
20.8.7.15 BM (type)	82.7	79.3	51.3	62.0	42.2	19.2	17.0	17.0	♂	Yunnan
22.10.21.16 BM	80.0	76.5	50.0	61.1	41.7	19.1	18.5	16.7	♂	Yunnan
25.10.5.29 BM	72.4	70.7	47.7	55.8	38.8	18.6	17.0	17.5	♀	Yunnan

These measurements indicate that while occasional old males may be of large size, on the average the males do not greatly differ in dimensions from females of approximately the same age. The sagittal ridge forms while the animals are still immature and becomes a knife-like crest in mature age.

Occurrence and Habits.—This race is presumably confined to the mountain areas of eastern China, and doubtless grades into the adjacent races to the

south (*R. sinensis sinensis*) and west (*R. s. vestitus*). The type locality, Kuatun, in the northwestern corner of Fukien, is its most northern known station, and here at the neighboring village of Chungan, Mr. Clifford H. Pope secured a series for the American Museum. He found it very common at altitudes of from 4,000-7,000 feet. It is readily trapped by the natives who say that it feeds upon the roots and shoots of bamboo. The Chinese name is "t'u lun." Somewhat farther south Mr. Pope secured a series in the mountains near Futsing, but writes that here it is found only at the higher altitudes. Cabrera (1922) has also recorded it from Foochow, probably again from the nearby mountains, while the American Museum Asiatic Expeditions have obtained it from the mountains at Yuki and Yenping in the same region. Young about six inches long (150 and 160 mm.) were among those taken by Mr. Pope at Kuatun on April 30 and May 2 respectively. The skulls of these young specimens show no trace of the interparietal which may be lost.

The species is named in honor of Père Armand David who made collections in the Kuatun area and discovered so many of the remarkable species of Chinese mammals.

Specimens examined:—In all, twenty-five, as follows:

Fukien: Chunganhsien, 14; Futsing, 13; Yenping, 4; Yuki, 1; no exact locality, 2; Kuatun, 1, the type (B.M.).

395. *Rhizomys sinensis vestitus* Milne-Edwards

Rhizomys vestitus Milne-Edwards, in David, Nouv. Arch. Mus. d'Hist. Nat. Paris, vol. 7, Bull., p. 92, footnote, 1871; Recherches pour servir à l'Hist. Nat. des Mammifères, p. 292, pl. 46; pl. 46a, figs. 2-2f, 1868-74.

Rhizomys sinensis J. Anderson, Anat. and Zool. Researches Western Yunnan, p. 300, 1879. Buechner, Bull. Acad. Imp. Sci. St. Pétersbourg, vol. 34 (new ser., vol. 2), p. 112 (Mélanges Biol., vol. 13, p. 158), 1892 (not of Gray).

Type specimens:—This race was described as a full species on the basis of two subadult animals taken by Père Armand David about 1870 "sur les confins du Khokhonor," amongst high mountains, that is, probably in Szechwan, China, somewhat west of Muping. Neither specimen is designated as the type; hence both are cotypes and presumably still in the Muséum d'Histoire Naturelle at Paris.

Description:—In general appearance the soft silky pelage is a nearly uniform brownish gray above. The hairs are darker gray basally, becoming pale gray in the distal half, then tipped with pinkish brown. On the head the hairs are light gray nearly or quite to their base, producing a somewhat paler effect. Ventrally the chin and lips are dull white to the bases of the

hairs; the throat has prominent gray bases to the hairs, while their tips are whitish; the rest of the ventral area is slightly paler than the back, a pale brownish gray, with the hairs dark gray. Backs of the feet and the tail scantily clothed with short, appressed, pale-brownish hairs. Vibrissæ pinkish brown. The nose has a large naked pad, the upper border of which is nearly straight across. A tendency to development of white markings is seen in some specimens, in which there is a triangular white area in the middle of the chest.

The skull is decidedly larger than in any of the other races.

Measurements:—The flesh measurements of four adults taken by W. R. Zappey in the Wa Shan region are as follows:

No.	Total length	Tail	Hind foot	Sex	Locality
7560 MCZ	451	89	60	♂	Szechwan
7561 MCZ	434	76	58	♀	Szechwan
7562 MCZ	395	61	57	♀	Szechwan
7563 MCZ	386	55	52	♀	Szechwan

For cranial measurements, see table under *R. s. davidi*.

Occurrence and Habits:—This race is characterized by its long, silky, pinkish-gray pelage, and by its large size, somewhat exceeding the races of southern China. As with the species elsewhere, it is found in the bamboo thickets at the higher levels on the mountains, and seems to have the most northern range of any in the genus, extending from central Szechwan northward to the borders of Kansu, where the rainfall and temperature conditions are suitable for bamboo growth. While the type locality cannot be identified certainly, it is probable that David's specimens came from somewhere slightly west of Muping. In 1908 W. R. Zappey secured four in the bamboo jungles of Wa Shan, central Szechwan, at 8,000 feet altitude, and Thomas in 1911 recorded a female from Omei Shan, slightly to the northeastward. Others were taken in the same country by Weigold as well as farther north in the Wassu region (Jacobi, 1922, p. 15). In 1885 Berezovski (Buechner, 1892) obtained three specimens of this bamboo rat from the vicinity of Choi Shan on the foothills of the Tsingling Range bordering Kansu and Shensi, as well as others from Tan Shan, west of Ssigu, northern Szechwan. The largest of these measured in the flesh: total length, 535 mm. An adult female, measuring 465 mm. in total length, contained three embryos, each 150 mm. long, in the end of April. According to Weigold, it is confined to the bamboo thickets where it is regularly caught by the natives with snares, and hence, he says, must often be abroad by day. One caught by his hound put up a stout but vain resistance with its powerful incisors. A. B. Howell (1929) has recorded specimens in the U. S. National Museum from Wenchwan and Wanh sien in

Szechwan, and I have examined a series in the Academy of Natural Sciences of Philadelphia, from Djengou in the same province. Of these latter, one female was captured May 6, 1931, with her three young ones which, though small, were thickly haired. From the dates available, it seems that the young, or at least the first brood, are born about the last of April.

Specimens examined:—In all, fourteen, as follows:

Szechwan: Wa Shan, 5 (M.C.Z.); Djengou, 6, including two young (A.N.S.P.); Omei Shan, 1 (B.M.); upper Min River, 2 (B.M.).

396. *Rhizomys sinensis wardi* Thomas

Rhizomys wardi Thomas, Journ. Bombay Nat. Hist. Soc., vol. 27, p. 504, March 31, 1921.

Rhizomys vestitus Pousargues, Bull. Mus. d'Hist. Nat., Paris, vol. 2, p. 182 (p. 4 of separate), 1896 (not of Milne-Edwards).

Type specimen:—The type is a skin and skull, No. 20.8.7.15, British Museum, a male, from the west flank of Imaw Bum, eastern Burma, altitude 9,000 feet. Collected October 25, 1919, by F. Kingdon Ward.

Description:—In general proportions similar to *R. s. vestitus*, but color quite different, for, whereas the latter is a decided pinkish gray in tint, the race *R. s. wardi* is much darker, a uniform dark drabby gray without sufficient brown to make any contrast between the bases and the tips of the hairs. The chin and upper throat as well as the center of the belly are a shade paler gray than elsewhere.

In skull characters this race is like that of eastern China, although the type and a topotype are of maximum size and possibly exceed the race *R. s. vestitus* in dimensions.

Measurements:—In dimensions this race is said to be larger than *R. s. vestitus*, but the type, although of nearly maximum size for the race, is nevertheless much smaller than those recorded by Buechner from Choi Shan. The dimensions of the type are: head and body, 380 mm.; tail, 95; hind foot, 51; ear, 19.

For cranial measurements, see table under *R. s. davidi*.

Occurrence and Habits:—This darker race of *R. sinensis* is "evidently widely distributed through the Yunnan highlands" (Thomas, 1923, p. 662) and westward into eastern Burma whence the type was procured (Imaw Bum). Thomas (*loc. cit.*) records a specimen from the northwestern flank of the Likiang Range at from 12,000-13,000 feet altitude, and adds that Mr. C. J. Gregory "recently obtained a specimen at Lanpinghsien, 26° 27' N., 99° 28' E." A specimen in the Museum of Comparative Zoölogy was collected by Dr. J. F. Rock in December, 1931, in Likiang, while as long ago as 1896, Pousargues

recorded that Prince Henri d'Orléans brought back three from Yunnan, secured for the Paris Museum in the course of his journey, although he referred them to *R. vestitus*. Farther east, the American Museum Asiatic Expedition under Dr. R. C. Andrews obtained two at Talifu, Yunnan, 6,700 feet altitude, in 1916. These are smaller than the type, measuring: head and body, 330, 340 mm.; tail, 85, 86; hind foot, 57, 56. No doubt, as often among rodents, these animals continue to grow throughout life, attaining a large size in old age, whereas the average adult size is considerably less. It would be interesting to trace this species farther eastward, and to determine if it occurs in Kweichow or in Kwangsi, where it might be expected at higher altitudes. Intergradation with the eastern races, *R. sinensis sinensis* and *R. s. davidi*, might be looked for in this area.

Specimens examined:—Five, in addition to the type from Imaw Bum, Burma, namely:

Yunnan: Talifu, 2; Likiang, 1 (M.C.Z.); east of Lanpinghsien, 1 (B.M.); hills northwest of Tengyueh, 1 (B.M.).

397. *Rhizomys pruinosus senex* Thomas

HOARY BAMBOO RAT

Rhizomys senex Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 16, p. 313, 1915.

Rhizomys pruinosus senex Osgood, Publ. Field Mus. Nat. Hist., zool. ser., vol. 18, p. 324, 1932.

Type specimen:—The type is an adult female, skin and skull, No. 12.7.25.42, British Museum, from Yunnan, China, probably in the vicinity of Mengtsh. Collected June 9, 1910, by H. Orii.

Description:—While in general size and proportions resembling *R. sinensis* in external appearance, this species differs in its coloring. The fur is long and soft, of a slaty blackish, with the longer hairs tipped with white, producing a strongly grizzled effect. On the ventral surfaces the coloring is nearly similar, but the white-tipped hairs are shorter and less numerous, and the general color is paler, slaty to grayish white. On the head and especially the sides of the face, the tips of the hairs wear off, exposing the paler whitish-gray bases. According to Anderson (1879), in old females the whole coat is sometimes "of a paler hue than in the generality of specimens" due to the abrasion of these tips which may be less numerous.

The chief differential characters of this race as described by Thomas are the larger size and heavier teeth, as compared with typical *Rhizomys pruinosus pruinosus* of Assam. The skull differs in numerous details from that of the *R. sinensis* group. The zygomata are not so squarely spread posteriorly; the nasals are prolonged behind the fronto-premaxillary suture instead of ending on the same level; the premaxillaries are much narrower, considerably

narrower than the corresponding nasal anteriorly; the rostrum is more slender, and the interorbital constriction is wide enough to about hide the sides of the palate, whereas in the latter it is so pinched-in that the waist does not hide the palatal area from above. The sexes do not show any marked difference in size.

Measurements:—No flesh measurements of Chinese specimens are available. The external dimensions, however, are about as in *R. sinensis*. Anderson (1879, p. 326) gives the following: for a male, head and body, 13.00 inches (about 330 mm.); tail, 4.00 inches (101 mm.); hind foot, 2.20 inches (56 mm.). The corresponding dimensions of a female are: head and body, 10.75 inches (269 mm.); tail, 3.75 inches (95 mm.); hind foot, 1.95 inches (50 mm.).

Thomas gives the following cranial dimensions of the type: condylobasal length, 67 mm.; condylo-incisive length, 66; zygomatic width, 48.7; nasals, 25 by 8.7; greatest breadth on frontals, 18.7; interorbital breadth, 10.5; occipital shield, height from basion, 22.5; breadth, 33; palatilar length, 37.2; upper molar series, crowns, 15.2; breadth of m^2 , 5.6.

Occurrence and Habits:—This species is at once distinguished from *R. sinensis* by its hoary coat and by the narrower rostrum and other minor cranial features. Its range as a species somewhat overlaps that of the latter, but is in general more southern. The typical *R. pruinus* is found in Assam, but the present slightly larger form is found across extreme southern Yunnan, and in eastern Burma. Anderson (1879) wrote that it is abundant in the Kakhyen Hills east of Bhamo, Burma, on the very borders of western Yunnan, and so no doubt may be expected within the boundaries of the province near that point. He found it absent from the high exposed and somewhat barren hills slightly to the east at Tengyueh, Yunnan. No doubt it will eventually be found all along the southern edge of Yunnan, at least as far as the type locality, itself close to the northern bounds of Tongking, Indo-China, where a number have been taken lately by expeditions from the Field Museum of Chicago. This species replaces *R. sinensis* at the lower levels, but apparently there is very little known of its habits. Anderson (1879) writes that three or four young are born to a litter.

Specimens examined:—One, the type (B.M.), from Mengtsz, Yunnan.

398. *Rhizomys pruinosus latouchei* Thomas

Rhizomys latouchei Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 16, p. 59, 1915.

Rhizomys prusianus Shih, Bull. Dept. Biol., Sun Yatsen Univ., Canton, no. 4, p. 9, 1930 (*lapsus*).

Rhizomys pruinosus latouchei Osgood, Publ. Field Mus. Nat. Hist., zool. ser., vol. 18, p. 324, 1932.

Type specimen:—An adult female, skin and skull, No. 92.2.1.27, British Museum, from Swatow, Kwangtung, China. Collected February, 1889, by J. D. La Touche.

Description.—This is a slightly larger race of the Assamese *R. pruinus*, from which it is externally indistinguishable otherwise. "Fur soft; hairs of back about 20 mm. in length. Colour of the most pronounced '*pruinus*' character, dark smoky grey profusely grizzled with the white ends to the longer hairs. Under surface rather paler. Top of muzzle darker. Area round mouth greyish white. Hands and feet brown, fingers whiter. Tail blackish, apparently without lighter tip. Mammæ, functional, 1 — 3 = 8, but there is in addition a minute anterior pair which have obviously never been used" (Thomas, 1915b).

The skull is said to be heavier than in typical *R. pruinus*, with nasals evenly narrowing backward; the antorbital foramen is less triangular than in other members of the genus; the interorbital region is broad, its edges square, slightly converging backward, and continuous with the parietal ridges, which remain separate throughout, not forming a median crest, in the type. Occipital plane more nearly vertical than in other species. The molar teeth are "rather light," the anteriormost worn down below the level of the other two.

Measurements.—No external measurements are available. The skull of the type, however, presents the following: condylobasal length, 69 mm.; condylo-incisive length, 67.5; zygomatic width, 50; mesial height of zygoma, 9; nasals, 26 by 9; occipital plane, height from basion, 21.5; width, 32; interorbital width, 13.2; upper molar series, crowns, 13.5.

The skull of the type still has the basal suture open, while the temporal crests have not yet met posteriorly.

Occurrence and Habits.—This race is apparently not very different from *R. p. senex* of Yunnan and southward, but is slightly larger, with a more nearly vertical occipital plane. The only locality definitely known is that whence the type came, Swatow in Kwangtung, and hence quite on the coast, and not so far from the type locality of *R. sinensis* whose range here it nearly touches. The latter species, however, is a mountain animal confined to the bamboo belt, while the members of the *R. pruinus* group are apparently found in lower country, ranging, according to Anderson (1879), eastward into Cambodia. According to Shih (1930), the two species occur in Kwangsi to the westward. He secured *R. pruinus* from a village in western Yao Shan in 1927, and on a later expedition obtained *R. sinensis* in low mountain forest to the eastward. Nothing is recorded of the habits.

Specimens examined.—One, the type (B.M.), from Swatow, Kwangtung.

Family SPALACIDÆ

MOLE-RATS

Like the Rhizomyidæ, this family is a derivative from microtine stock

to which its molar teeth, with their series of alternating triangular prisms, bear witness of close affinity. It is likewise more modified for a fossorial life underground. Miller and Gidley emphasize as a distinguishing trait the peculiar form of the antorbital foramen which, instead of having a wide upper portion for the transmission of a muscle band and a narrow lower cleft for the transmission of a branch of the fifth nerve, has the "zygomatic plate narrowed and turned downward to a nearly horizontal position, thus doing away with the separate neural portion of the opening by a process the exact opposite to that bringing about a similar result in some of the *Rhizomyidæ*." The skull shows extreme fossorial adaptation in its nearly straight dorsal profile, flattened rostrum, wide zygomata, and the prominent lambdoid ridges which are "carried forward to the level of the zygomatic root." Two subfamilies are known, the *Spalacinæ*, including the blind mole-rats of western Asia and southeastern Europe, in which the molar teeth are rooted, and the *Myospalacinæ*, in which the molars are ever-growing from persistent pulps. Only the latter group, containing the single genus *Myospalax*, is known in the present-day fauna of China and Mongolia. A perplexing number of "species" have been named from this area, but some of these are clearly based on characters that are individually variable, and the latitude of this variability is itself rather considerable. For this reason, too, one inclines to doubt the validity of several forms described from cranial fragments attributed to the Pleistocene of China. The species and subspecies living in China at the present day, so far as here made out, may be identified by the key on pages 915 and 916.

Genus *Myospalax* Laxmann

Myospalax Laxmann, *Sibirische Briefe*, pp. 74-77, 1769. T. S. Palmer, *North Amer. Fauna*, no. 23, p. 440 and footnote, 1904.

Myotalpa Kerr, *Animal Kingdom of Linnæus*, vol. 1, *Mamm.*, p. 246, 1792 (as a subgenus of *Mus*). J. A. Allen, *Bull. Amer. Mus. Nat. Hist.*, vol. 7, pp. 181, 183, 1895 (type fixed).

Siphneus Brants, *Het Geslacht Muizen*, p. 19, 1827. Milne-Edwards, *Recherches pour servir à l'Hist. Nat. des Mammifères*, p. 72, 1868-74.

In northern China and adjacent parts of Siberia and Mongolia this genus occupies a niche somewhat similar to that taken by the gophers in North America, though believed to be derived from an unrelated ancestral type. Externally it has a stout, chunky form, with short powerful limbs, the fore feet armed with immense claws for digging, of which the middle or third claw is the longest and heaviest, the fourth much shorter but proportionately as stout, while the second claw is slightly longer than the fourth but much more slender and compressed laterally. The first and fifth digits have each a short strong claw. In the hind feet the claws are much shorter, those of the second and third digits the longest and subequal, those of the first and fourth much

shorter but stout, while the fifth digit has a very small blunt and conical claw. There are no external ears and the eyes are very small, nearly hidden in the fur. The tail is also reduced, barely longer than the hind foot. The mammae are six, one pair pectoral, two pairs abdominal. The coat is composed of abundant long silky hairs, without coarser guard hairs, while the vibrissae are short and few. There is a prominent naked nose-pad, at the sides of which the nostrils open. Milne-Edwards (1868-74) has given a detailed account of the anatomy of a species of this genus, with excellent figures of the muscles, intestinal tract, and skeleton. In typical *Myospalax* the nasals are nearly flat, and the upper profile is practically straight from occiput to base or even tip of nose. The bluntly truncate occipital shield makes nearly a right angle with the dorsal outline, but the palate is strongly sloping, giving the profile of the skull nearly the shape of a right-angled triangle. The temporal ridges are low but well marked, extending back parallel to each other from the orbit. The latter is small and nearly dorsal in position, with a prominent projection behind it from the squamosal, as in the Microtinæ. The incisor teeth are stout but not proclivous in the upper jaw, their tips curving backward instead, and their roots extending slightly behind the premaxillary so that their capsules encroach upon the inside of the antorbital foramina. The lower incisor is relatively weak in *M. myospalax*, and its root, but slightly curved, passes back well below the roots of the lower molars and ends just behind and on a level with the dental foramen. The enamel pattern of the molars is decidedly reminiscent of the microtines, but the two posterior teeth are somewhat reduced in the number of enamel spaces, of which the postero-external is the last in the upper molars and turns conspicuously outward. The palate is essentially as in typical *Microtus*, with a strong bony bridge extending upward from the palatal level to the mid-point between the shallow lateral pits, and ending in a distinct median spine.

A number of "species" of this genus have been named from northern China, but there is still much doubt as to their exact affinities. Probably, as with other subterranean mammals, these rodents tend to form more or less isolated colonies, depending in part upon the local conditions of soil and topography, so that slight differences develop in local areas, and may become sufficiently important to form a basis of subdivision. The genus ranges into the Transbaikal area and northern China.

KEY TO THE CHINESE FORMS OF *Myospalax*

- A. Skull with the occipital surface sharply truncate from the level of the lambdoid crests, and only slightly wider than high; rostrum with its profile depressed, antorbital foramen narrowed ventrally, incisive foramina confined to the premaxillæ.

Subgenus *Myospalax*

KEY TO THE CHINESE FORMS OF *Myospalax* (Cont'd)

- a. First upper molar with but a single reëntrant on the inner side, opposite the middle one of the three external projections *M. armandii*
- b. First upper molar with two reëntrants on the inner side, the anterior one cutting off an antero-internal triangle. *M. myospalax psilurus*
- B. Skull with the truncate occipital surface less abrupt, standing off from the lambdoid crests, and much wider than high; rostrum with profile forming a straight line continuing the plane of the brain case; antorbital foramen not narrowed ventrally; incisive foramina about half included within the maxillæ. Subgenus *Eospalax*
 - a. Orbital rim overhanging, temporal ridges parallel, posterior border of nasals notched.
 - a'. Tail nearly naked, sparsely clothed with minute hairs, its length over 40 mm.
 - a''. A prominent white blaze on the forehead; larger, skull length in adults usually 45 mm. or more. *M. fontanierii fontanierii*
 - b''. Forehead usually without a white blaze, or if present, small; size less, skull length in adults usually less than 45 mm. *M. fontanierii cansus*
 - b'. Tail densely hairy, and short, usually less than 40 mm.
 - a''. Larger, claws stout, skull length more than 45 mm. . . *M. f. baileyi*
 - b''. Smaller, claws delicate, skull length less than 45 mm. *M. rothschildi*
 - b. Orbital rim not overhanging, temporal ridges meeting in the median line, posterior border of nasals transverse. *M. smithii*

Subgenus **Myospalax** Laxmann

Myospalax Laxmann, Sibirische Briefe, pp. 74-77, 1769.

The type species of the genus and typical subgenus is *Mus myospalax* Laxmann (Kongl. Vet.-Akad. Handl., Stockholm, vol. 34, p. 134, 1773). As explained by Sherborn (in Palmer, 1904, p. 441), Laxmann first used the name in a generic sense only, but "afterwards relegated it to specific rank." In its narrowed and sharply truncate occipital surface, the skull is markedly different from that of the members of the subgenus *Eospalax*. Laxmann's original specimen came from Barnaul, western Siberia, and represents a different animal from Pallas's *Mus aspalax*, of Dauria.

399. **Myospalax myospalax psilurus** (Milne-Edwards)

Siphneus psilurus Milne-Edwards, Recherches pour servir à l'Hist. Nat. des Mammifères, p. 126, pls. 9a, 9b, 1868-74.

Siphneus spilurus Trouessart, Cat. Mamm. Viv. Foss., p. 568, 1897 (*errorim*).

Myotalpa spilurus Trouessart, Cat. Mamm. Viv. Foss., p. 465, 1904 (*errorim*).

Myotalpa psilurus Jacobi, Abh. u. Ber. Mus. f. Tier- u. Völkerk., Dresden, vol. 16, no. 1, p. 15, 1922.

Myospalax psilurus Lönnberg, Arkiv f. Zool., Stockholm, vol. 18A, no. 21, p. 5, 1926.

Type specimen.—The species was described from a specimen sent from "les champs sablonneux, au sud du Pékin," Hopei, China, where it was collected by Père Armand David about 1867. Presumably it is still in the Muséum d'Histoire Naturelle at Paris.

Description.—The cheeks and forehead are clothed with short, stiff fur, ashy in color with a tinge of fawn, becoming gray in the midline behind the eyes. A small white occipital spot is present. Rest of the upper surface uniform in color, the hairs broadly slaty at the base, with a short pale-russet tip, giving a general light russet color to the whole back. At the sides this tint passes gradually into the paler tint of the belly, where the hairs are slaty based, tipped with grayish, and faintly suffused in the midline with pale tawny or russet. The wrists are whitish. Backs of the feet and the tail nearly naked, but on close inspection seen to be covered with minute gray hairs.

The fore claws are very large and strong, that of the third finger longest and stoutest, that of the fourth finger equally stout but about two-thirds as long, and subequal in length to the second claw which, however, is much more slender and laterally compressed. The fifth claw is stout and nearly half as long as the fourth, but the first claw is small and very thin, compressed laterally. The hind claws are much smaller, the second and third like the corresponding toes, longest and subequal, the fourth much shorter, its tip just reaching the base of the third claw, while the fifth and first are very small, the former the stouter.

The skull is very distinctive, and so clearly like that of typical *M. myospalax* in structure that there is no doubt of the close affinity of the two, as Milne-Edwards originally indicated. The salient points are: (1) the ant-orbital foramen is more normal in outline, pear-shaped, with the ventral portion much narrowed; (2) the anterior edge of the antorbital plate, as seen from above or from the side, slopes evenly forward and inward, instead of flaring widely outward, and is not projected forward and continued as a raised beaded line curving backward on the under side of the palate; (3) in profile view the tip of the nasals is slightly depressed instead of continuing the straight dorsal line of the skull; (4) the ascending branches of the premaxillaries slightly surpass the nasals in backward extension; (5) the temporal ridges begin at the anterior corner of each eye and pass back nearly or quite parallel from the inner margin of the orbit to the lambdoid crest, enclosing a deep gutter or trough between them; (6) the posterior end of the skull is abruptly truncate from the level of the lambdoid ridge instead of being continued behind this level; and (7) when viewed from behind the occipital area is narrow and high, the distance from the lower border of the condyle to the summit of the lambdoid crest nearly equaling its greatest transverse width (falling short by about the

transverse diameter of one condyle), instead of being only two-thirds this width. The ridges on the anterior edge of the squamosal are very little developed so that when viewed from above the posterior border of the orbit slopes evenly away backward instead of being recurved forward as in the *M. fontanierii* group.

The enamel pattern is essentially as in the latter except that the reëtrant angles are slightly less deep. There are two inner reëtrants in the first upper molar and two outer ones alternating with them, cutting off two outer and two inner somewhat triangular spaces and a postero-external loop which turns outward and forward. The second upper molar is similar except that there is no anterior inner reëtrant, and hence but a single anterior space, nearly transverse, and of crescentic form, not divided into two triangles. The third upper molar is nearly like the second, with an anterior nearly transverse crescent, followed by an outer and an inner triangle, which, however, are more or less confluent with each other and slightly, in some specimens, with the postero-external crescent. The lower incisor has a longer root than in the *M. fontanierii* group, extending upward behind the dental foramen, and making a decided bulge on the outer face of the ramus just below the condyle. The first lower molar has a posterior transverse crescent, in front of which are an inner and an outer closed triangle and an anterior space consisting of an inner and an anterior rounder loop, both confluent. The second lower molar consists of a posterior crescent, with, in front of it, an inner and an outer closed triangle, and an anterior space, which is really made up of a small outer and a larger inner triangle completely open at their bases. The last lower molar is more reduced, consisting of an anterior transverse space with its outer part pointed and small, its inner part much larger and somewhat squared, followed by an outer closed triangle and an inner nearly triangular lobe.

Measurements:—No flesh measurements of this mole-rat are available. It evidently attains large size, however, a made-up skin giving the following: head and body, about 270 mm.; tail, about 35; hind foot, with claw, 48.5.

CRANIAL MEASUREMENTS OF *MYOSPALAX*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
<i>M. myospalax psilurus</i>									
20587 MCZ	46.7	43.0	27.1	32.3	—	10.4	11.0	11.6	Hopei
8.2.23.1 BM	44.1	40.0	26.1	30.0	27.9	9.9	10.3	11.1	Hopei
8.10.14.1 BM	46.0	42.0	26.6	—	26.8	10.5	11.0	12.1	Hopei
26.1.3.14 BM	44.5	39.7	25.8	29.6	27.7	9.7	9.8	10.8	Shantung
14.8.26.8 BM	45.3	40.3	25.7	31.3	27.5	10.0	10.0	11.0	Jehol
16.1.1.9 BM	43.7	39.0	25.3	30.7	26.0	9.5	9.9	10.5	Jehol

CRANIAL MEASUREMENTS OF *MYOSPALAX* (Cont'd)

No.	Greatest length	Basal length	Palatal length	Zygo- matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
<i>M. armandii</i>									
67.12.2.4 BM	46.6	41.0	25.7	31.0	27.0	9.9	9.5	—	Mongolia

Occurrence and Habits:—In all its cranial characters this mole-rat is so evidently related to *Myospalax myospalax* of the Altai region that I do not hesitate to regard it as a subspecies, differing in its more russet coloring and in a few minor details of the skull. As a species this is evidently a more northern animal than the other Chinese species, for Pallas obtained the same specific type in Dauuria, just north of northern Mongolia, as long ago as 1772. He named it *Mus aspalax* and called attention to its similarity to the *Mus myospalax* of Laxmann described a year earlier from "circa Altaica promontoria." While it may eventually prove that Pallas's name will apply in a subspecific sense to the Dauurian animal, it seems unlikely that the Hopei form is the same, so that in the absence of specimens from Dauuria, Milne-Edwards's *Siphneus psilurus* is here given subspecific standing. *Myospalax epsilanus* of the Khingan Mountains is also evidently at most a local race.

Very little seems to have been recorded of this large mole-rat. Externally it closely resembles the *M. fontanierii* type, but the skull with its very truncate occiput and little-modified antorbital region is quite distinctive. Père Armand David, who first brought the animal to the attention of Europeans, secured it in the sandy fields south of Peiping. Jacobi (1922) next reported a series of fourteen adults from Balihandien, which is northeast of Chengtefu, Jehol. One of these is now in the Museum of Comparative Zoölogy, and its measurements are given above. Jacobi gives the extremes of measurements of the series, from which it appears that the largest had a skull length of 49.3 mm., while the largest made-up skin was 330 mm. in length. The collectors Stötzner and Weigold found it only in the valleys of the wooded cemetery of Prince Han. They secured the series, with the help of the natives, by digging them out with much difficulty, for often the burrows were forty meters long and among roots of trees and bushes. Every three to six meters there would be a large mound of earth thrown out. The animals appear to be sensitive to light, even though the eyes are so small, and run about seeking a place suitable for digging themselves in when released. They can dig with remarkable speed, throwing out the loosened earth with the hind feet after every three or four scrapes with the powerful fore claws. The secretion of the lachrymal glands was found to be very profuse and milky white, presumably aiding in keeping the eyes free from particles of earth. Sowerby (1914) writes that these animals make poor pets on account of their savage dispositions. One that he kept free in his room was found one day to have "bored its way through the

entire thickness of the bed-clothes,—mattress, blankets, quilt and all.” Lönnberg (1926) has recorded a specimen taken at Tahsing in Hopei, and there are specimens in the British Museum from Yangtien near Tientsin, and from Chih-feng in Jehol, as well as from Tsinan, Shantung, the most southern record available. In one of the Yangtien specimens the inner half of each upper incisor is white instead of the usual orange.

Specimens examined:—The following seven:

Jehol: Chihfeng, 2 (B.M.).

Hopei: Balihandien, 1 (M.C.Z.); Yangtien, near Tientsin, 3 (B.M.).

Shantung: Tsinan, 1 (B.M.).

400. ***Myospalax armandii*** (Milne-Edwards)

Siphneus armandii Milne-Edwards, Ann. des Sci. Nat., Zool., ser. 5, vol. 7, p. 376, 1867. Recherches pour servir à l'Hist. Nat. des Mammifères, p. 120, pl. 6; pl. 8, figs. 10-12; pl. 9, figs. 1-4, 13-19, 1868-74.

Type specimen:—In the original description no type is specified, but it may be inferred that more than one specimen was secured from “les hauts plateaux de la Mongolie,” perhaps on the northern borders of Shansi, about 1867, and sent by Père Armand David (in whose honor it is named) to the Paris Museum where they presumably still are.

Description:—In his more extended description Milne-Edwards states that externally this species is not very different from *M. myospalax* of Siberia, but in general the pelage is softer and more silky, less reddish and more grayish, with the anterior part of the head a slightly clearer white. The colored plate shows a uniformly pale russet color, except for the whitish frontal area and ear spots. The claws of the fore feet are equally stout as in the other species, that of the outermost digit even a trifle longer, while the third digit of the hind foot is a little larger.

The chief difference is found in the teeth, for there is but one inner reëntrant angle to the first upper molar so that, instead of a short anterior transverse space followed by an inner triangle, there is a crescent sloping outward. The third upper molar differs in having the posterior lobe of the tooth with the salient angles very little marked; it is much shorter than the corresponding tooth of *M. myospalax* and tapers posteriorly. In other respects, as in the narrow and high occipital shield, sharply truncate from the level of the lambdoid crests, it seems to resemble that species very closely. Like it, the temporal ridges form pronounced parallel crests with a trough-like depression between them. A specimen, skin and skull, in the British Museum, is one of those collected by Père David in “Mongolia,” apparently an aged example, with the low, parallel temporal ridges much thickened. The rostrum is a little wider than that of *M. m. psilurus*, expanding in the middle; the incisive foramina are not quite wholly within the premaxillary boundaries, but nevertheless

are short as in that species. The enamel folds of the cheek teeth are nearly parallel in a transverse plane, instead of closing to cut off triangles. The last molar is shorter than in *M. m. psilurus* and has the three outer salients nearly transverse to the axis of the tooth instead of forming four triangles. These are possibly matters of wear with age. The palate ends level with the anterior end of the last molar instead of continuing to the level of its first third. There is no trace of a reëntrant angle on the inner side of the anterior crescent of the first upper molar, one of the most obvious differences from the other species of the genus, but this is a character possibly subject to slight variation, for in a specimen of *M. m. epsilonus* the usual deep indentation is very shallow, and the same is true of a specimen representing typical *M. myospalax* from the Altai. The skin itself shows a short heavy tail, heavy claws, muzzle whitish, forehead smoky, with a very small white blaze.

Measurements.—No external measurements are available from fresh specimens, but the size is apparently about as in *M. m. psilurus*.

The cranial measurements are given in the table under *Myospalax m. psilurus*.

Occurrence and Habits.—It is very remarkable that no one seems to have met with this species since its original discovery by Père David on the Mongolian plateau at some point not precisely known. The same energetic collector later discovered parts of a skeleton with a nearly complete skull in some sandy deposits "de Mongolie." It is well known that David lived for some time at Saratsi in northern Shansi, then considered a part of Mongolia, hence he may have obtained his specimens in that general region. The fact that no one seems to have come upon it since may indicate that it is a very local form. Were it not that Milne-Edwards's figures of the peculiar tooth pattern are so very clear, one might almost suppose that some mistake in representing it had been made, and that the animal was, after all, much the same as, if not quite identical with, *M. m. psilurus*. I have, however, had the opportunity of studying one of Père David's original specimens in the British Museum, and, though it is externally similar to the latter, the peculiarity of the molar-tooth pattern, particularly in the lack of the first inner reëntrant of m^1 , seems characteristic. The possibility of intergradation with other forms to the west and east is not yet to be dismissed, and although tentatively regarded as a separate species, it may later prove to be only a race of *M. myospalax*.

Specimens examined.—One, from "Mongolia," probably northern Shansi (B.M.).

Subgenus **Eospalax** G. M. Allen

Eospalax G. M. Allen, Mammals of China and Mongolia (Nat. Hist. Central Asia, vol. 11, pt. 1), p. vii, September 2, 1938. Type, *Myospalax fontanierii* (Milne-Edwards).

401. *Myospalax fontanierii fontanierii* (Milne-Edwards)

Siphneus fontanierii Milne-Edwards, Ann. des Sci. Nat., Zool., ser. 5, vol. 7, p. 376, 1867; Recherches pour servir à l'Hist. Nat. des Mammifères, p. 122, pl. 7; pl. 8, figs. 6-9, 13; pl. 9, figs. 5-8; pls. 9c-9e, 1868-74.

Myospalax fontanieri Thomas, Proc. Zool. Soc. London, for 1908, p. 978, 1909.

Myospalax fontanus Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 9, p. 93, 1912. Lönnberg, Arkiv f. Zool., Stockholm, vol. 18A, no. 21, p. 3, 1926. West of Ningwufu, Shansi.

Type specimen.—The type was a specimen sent by the French Honorary Consul Fontanier from the vicinity of Peiping, Hopei, China, to the Muséum d'Histoire Naturelle at Paris where it presumably still is. It was probably collected about 1866 or 1867.

Description.—Upper lips and the muzzle from the nose-pad back to at least the level of the eyes, soiled white, with or without a short streak of clearer white in the midline of the vertex. The occiput on either side of this streak is pale grayish brown. Sides of the muzzle gray. Elsewhere the entire dorsal surface of the body has the bases of the hairs slaty, their tips grayish brown to pale tawny, slightly brighter in the midline, and the whole pelage somewhat silvered as the light catches the polished ends of the hairs. Chin and throat gray, the rest of the under side much like the back but less suffused with tawny or cinnamon. Metapodial area of fore and hind feet scantily clothed above with minute whitish hairs, the tail similarly accoutred, both appearing nearly naked. Young animals are uniformly dark gray, with the tips of the hairs paler or slightly shining.

The skull in this group differs markedly from that of the *M. myospalax* section. In profile the nasals continue the straight line of the back of the skull without being obviously depressed at the tip; the lambdoid crest is interrupted in the midline; the temporal ridges are low and sharp in adults and become finally about parallel, starting from the overhanging antorbital region; the antorbital plate is more flattened out, rounded ventrally, with its outer anterior border produced forward and a raised ridge running from the most anterior point of the border down on to the ventral side of the palate. Finally a great difference lies in the occipital shield, which is not so truncate but bulges backward from the lambdoid crests, has a relatively great transverse width as compared with the height, and in adults shows a narrow tongue-like groove extending up on either side; these grooves, though not quite meeting with each other dorsally, cut off a smaller posterior surface. In Milne-Edwards's figure of the type skull the rostrum is shown as rather conical, its sides slightly converging distally instead of more parallel-sided. On the basis of this character, Thomas described as a distinct species *M. fontanus*, to include the animal with parallel-sided rostrum, restricting the name *M. fontanieri* to the former. In other respects, however, the two are the same, and there can be no doubt that the difference is a matter of age, sex, or individuality, for, as the figure shows, Milne-Edwards's specimen was not fully adult, and has the basal suture

still open, so that the conical outline of the muzzle may be correlated with immaturity; moreover, of thirteen specimens taken near the original locality and reported on by Lönnberg (1926), only one was of the type with conical rostrum. Another point of difference in comparison with *M. myospalax* consists in the fact that the suture between premaxillaries and maxillaries on the ventral side comes to about the middle of the incisive foramina, whereas in the latter species it passes just behind these openings, which are therefore wholly contained in the premaxillaries. These and other differences show that the genus falls readily into two groups, the typical *Myospalax* from the Altai to the Transbaikal area, and a more southern group, typified by *M. fontanierii*, of northern China. In the key I have made this latter a distinct subgenus under the new name *Eospalax* (see pt. I, p. vii, of this work).

Skulls of full-grown males are slightly larger and heavier than those of comparable females, with slightly broader muzzles and heavier incisors. Usually there is a curious shallow constriction on the outer side of each nasal near the tip, varying in individuals, and sometimes, as in the one figured by Milne-Edwards, practically lacking.

In all the series from Ningwufu in the British Museum, the last upper molar has a small indentation in the enamel border of the postero-external lobe. The specimens all have the basal suture open, so are not fully adult. The tooth row apparently increases very slightly with age and wear. In all, the posterior ends of the nasals are slightly beveled off to form a forwardly pointing V between them, and end slightly in advance of the ends of the premaxillæ.

Measurements.—The following measurements from specimens in the flesh are recorded on the labels:

No.	Head and body	Tail	Hind foot	Ear	Sex	Locality
37857	172	59	34.0 (s. u.)	—	♂	Shansi
155082 USNM	204	54	37.5 (s. u.)	—	♂	Shansi
172633 USNM	216	65	36.0	—	♂	Shansi
172636 USNM	201	61	36.0	—	♂	Shansi
172645 USNM	176	59	34.0	—	♂	Shansi
172634 USNM	173	53	30.0	—	♀	Shansi
172635 USNM	186	58	29.0	—	♀	Shansi
172638 USNM	183	56	31.0	—	♀	Shansi
172639 USNM	175	60	32.0	—	♀	Shansi
172640 USNM	171	69	31.0	—	♀	Shansi
172641 USNM	181	53	31.0	—	♀	Shansi
172643 USNM	177	55	31.0	—	♀	Shansi
172644 USNM	185	58	32.0	—	♀	Shansi



FIG. 44. *Myospalax* (*Eospalax*) *fontanierii*, outline of the last upper molar (British Museum). Ningwufu, Shansi. Much enlarged.

CRANIAL MEASUREMENTS OF *MYOSPALAX FONTANIERII*

No.	Great- est length	Basal length	Pala- tal length	Zygo- matic width	Width of oc- cipital shield	Height of oc- cipital shield	Width across molars	Upper cheek teeth	Lower cheek teeth	Sex	Locality
<i>M. fontanierii fontanierii</i>											
37857	48.7	43.5	28.2	33.3	31.0	20.0	10.5	11.3	12.6	♂	Shansi
56852	51.5	45.5	29.6	36.1	34.0	—	10.0	11.5	11.9	♂	Hopei
19896 MCZ	(52.5)	50.5	31.7	(43.0)	36.2	24.0	11.2	12.1	12.6	♂	Shansi
155082 USNM	49.5	45.5	29.1	35.3	32.2	20.8	10.0	10.8	11.8	♂	Shansi
172633 USNM	54.0	49.1	31.9	38.7	37.3	23.7	11.0	12.1	12.1	♂	Shansi
172636 USNM	49.5	45.0	29.2	35.7	33.7	22.5	10.4	11.5	12.5	♂	Shansi
172642 USNM	49.5	45.6	29.9	36.0	32.5	20.4	10.7	11.5	12.4	♂	Shansi
172645 USNM	46.4	42.4	27.3	30.4	27.7	19.2	10.4	11.4	12.2	♂	Shansi
9.I.I.203 BM	58.4	52.1	33.4	43.7	40.3	24.3	11.1	13.8	14.0	♂	Shansi
9.I.I.204 BM	55.7	50.1	31.2	38.3	35.8	22.4	11.0	12.5	13.6	♂	Shansi
9.I.I.209 BM	52.6	46.9	29.7	38.7	36.5	23.7	11.2	11.6	11.7	♂	Shansi
(type of <i>M. fontanus</i>)											
19897 MCZ	50.2	45.0	28.3	36.3	33.0	20.4	10.1	12.2	12.4	♀	Shansi
172635 USNM	—	42.0	27.2	32.1	30.4	19.7	9.9	11.7	12.0	♀	Shansi
172638 USNM	49.5	45.3	29.0	35.8	31.6	21.3	11.5	12.2	12.2	♀	Shansi
172641 USNM	47.0	42.1	27.4	32.6	29.3	18.5	9.8	10.7	11.5	♀	Shansi
172643 USNM	46.6	41.7	27.0	32.1	29.9	19.2	10.1	11.4	11.6	♀	Shansi
172644 USNM	50.6	45.8	29.9	35.6	33.2	20.7	10.3	11.8	12.3	♀	Shansi
174994 USNM	45.5	41.5	26.7	30.7	28.6	19.6	9.4	10.7	11.4	♀	Shansi
<i>M. fontanierii cansus</i>											
24140 MCZ	41.7	36.8	23.7	26.9	22.9	15.5	8.6	9.3	10.0	♂	Kansu
155175 USNM	46.5	43.4	27.6	35.2	32.1	18.5	9.3	10.6	11.0	♂	Kansu
175176 USNM	47.0	42.0	27.0	30.7	28.2	17.0	9.5	11.5	10.9	♂	Kansu
155085 USNM	44.3	39.6	25.3	30.0	25.9	16.1	8.7	10.5	11.5	♂	Shensi
155088 USNM	44.5	39.5	25.5	28.6	26.1	16.0	8.2	9.5	10.5	♂	Shensi
9.I.I.216 BM	48.0	42.5	27.3	33.5	31.0	17.5	10.2	12.4	12.6	♂	Shensi
(type of <i>M. c. shenseius</i>)											
9.I.I.215 BM	47.2	42.7	27.1	33.1	29.5	18.4	10.3	11.5	11.8	—	Shensi
155174 USNM	41.0	37.5	24.1	26.8	25.0	16.4	8.9	10.0	11.0	♀	Kansu
155083 USNM	42.7	38.6	25.1	—	24.5	15.7	9.7	9.6	9.7	♀	Shensi
155084 USNM	44.3	39.5	25.5	29.9	26.1	16.4	9.7	10.7	11.0	♀	Shensi
155086 USNM	42.4	37.9	24.3	28.8	26.1	17.7	9.6	10.8	11.4	♀	Shensi
240754 USNM	42.6	39.3	25.8	29.1	26.5	18.2	9.1	10.0	10.1	♀	Kansu
32297	44.4	40.0	25.7	29.7	26.6	15.8	8.7	10.3	11.6	♀	Kansu
<i>M. fontanierii baileyi</i>											
11.10.3.6 BM	41.2	—	24.0	29.0	28.5	17.4	9.2	9.8	9.8	♀	Szechwan
(type)											

Occurrence and Habits:—This species is the largest of the group with the broad occipital shield, and equals *M. m. psilurus* in size. It seems clear, too,

that the occasional difference in the outline of the rostrum, made by Thomas the basis for his species *M. fontanus*, can hardly be a specific character but rather a matter of individual development, for the two types are found together in the same localities, as Lönnberg demonstrated, although he followed Thomas in supposing that they represent two species otherwise indistinguishable. Combining, then, *M. fontanus* as a synonym of *M. fontanierii*, the range as at present known extends from localities northwest of Peiping, close to the edge of the Mongolian plateau [as Siwan (Milne-Edwards); Joho, Luan Ping, Lung Kuan, Hsuanhua (Lönnberg)] southward probably into southern Hopei, and westward into at least northern and central Shansi to the Ordos Desert. Thus A. B. Howell (1929) records specimens in the U. S. National Museum (as *M. fontanus*) from localities in Shansi: twenty miles west of Ningwufu (topotypes of *M. fontanus*), ten miles south of Wutsai, and ninety miles west of Taiyuanfu. Thomas (1909) records eleven from the general region, and Lönnberg adds to the Shansi localities Paotehchow and It City, the former on the very border of the Ordos Desert. Slightly farther north in the same province, Dr. F. R. Wulsin secured two specimens near Yirgo, twenty miles northwest of Kweihwacheng, now in the Museum of Comparative Zoölogy. Two skins without skulls from one hundred miles northeast of Peiping obtained by the Central Asiatic Expeditions may be provisionally referred to the same species. In its typical form therefore this race occupies the northeastern corner of China in the provinces of Hopei and Shansi, avoiding the desert. To the south and southwest it becomes progressively smaller.

A. B. Howell (1929) quotes from notes supplied by A. de C. Sowerby that the specimens the latter secured were either dug up by the natives while working in their fields or had been flooded out by irrigation. He once watched one work its way with remarkable rapidity into the packed ground of a Chinese courtyard. They dislike light and always try to hide in some dark corner if prevented from burrowing. In feeding, the fore feet are used to hold the food down. Very little has been recorded of the life history beyond the bare facts of occurrence. Of parasites, Jordan and Rothschild (1911) record two new species of fleas, *Amphipsylla casis* and *Neopsylla aliena*, from a mole-rat from Yulinfu, referred to this species, but probably representing the following race.

There is some variation in the extent of the white markings. Usually there is a small occipital streak that is more or less continuous with a larger patch involving the upper side of the muzzle and often the upper lips. Westward, in central Shansi, the condition is more like that typical of the race *M. f. cansus*, in which usually the forehead mark, when present, is distinct from that of the muzzle. In a skin from one hundred miles northeast of Peiping additional albinistic tendency is shown, for the wrists, the upper side

of the right forearm, most of the right flank and the extreme posterior part of the rump are white. There is a small white patch on the left flank that nearly joins that of the right flank in the middle of the belly posteriorly. As with white markings in general, there is thus a tendency to be irregular. In another specimen from Wutsai, Shansi, there is a small white spot in the middle of the belly.

Specimens examined:—The following thirty-one:

Shansi: Yirgo, twenty miles northwest of Kweihwacheng, 2 (M.C.Z.); Wutsai, twenty miles west of Ningwufu, 20 (U.S.N.M., B.M., M.C.Z.); ? Maitaichao, forty-three miles east of Paotow, 1; Taiyuanfu, 2 (U.S.N.M.); Chiao-cheng Shan, 1 (U.S.N.M.); northwest of Kolanchow, 2 (B.M.).

Hopei: one hundred miles northeast of Peiping, 2.

Shensi: north of Chingpien, 1 (B.M.).

402. *Myospalax fontanierii cansus* (Lyon)

Myotalpa cansus Lyon, Smithsonian Misc. Coll., vol. 50, p. 134, pl. 15, figs. 4-10, 1907.

Siphneus fontanieri Buechner, Bull. Acad. Imp. Sci. St. Pétersbourg, vol. 34 (new ser., vol. 2), p. 112 (Mélanges Biol., vol. 13, p. 158), 1892 (not of Milne-Edwards).

Myospalax cansus Thomas, Proc. Zool. Soc. London, for 1908, p. 978, 1909. A. B. Howell, Proc. U. S. Nat. Mus., vol. 75, art. 1, p. 54, 1929.

Myotalpa rufescens J. A. Allen, Bull. Amer. Mus. Nat. Hist., vol. 26, p. 428, 1909. Taipai Shan, Shensi.

Myospalax cansus shenseius Thomas, Abstract Proc. Zool. Soc. London, February 14, 1911, p. 5; Proc. Zool. Soc. London, 1911, p. 178. A. B. Howell, Proc. U. S. Nat. Mus., vol. 75, art. 1, p. 55, 1929. Yulinfu, Shensi.

Type specimen:—The type is an adult skin and skull, No. 144022, U. S. National Museum, from Taocheo (or Taochow), Kansu, China. Collected May 7, 1906, by W. W. Simpson. The type was said to be a female, but, as stated by Thomas (1909), is probably a male.

Description:—This is a smaller race, similar in nearly all respects to *M. fontanierii*, but not attaining so great a size, the largest males having skulls about equal in dimensions to those of the adult female of the typical race. The coloration is about the same in both, the upper surface of the body a dull pinkish buff, with the bases of the hairs chiefly dark slaty. The forehead is smoky brown, usually without a white streak but there may be a white patch extending back from the upper margin of the nose-pad to the level of the eyes. In other specimens this is nearly or quite absent, and in general is less extensive than in typical *M. fontanierii*. The throat is gray, the belly more or less washed with the same tint as the upper side, but the slaty bases of the fur are more prominent, due in part to a diminished amount of the ochraceous tint and in part to its having worn away. Some individuals are darker, with less pinkish buff all over, more gray. The backs of the feet and the tail all around are almost naked, but with a very sparse coat of minute whitish hairs. The grayer color is perhaps in part a result of immaturity. Thomas notes that in

a series of twenty-eight only five have the small white streak between the eyes, and often the whitish nose patch is wanting.

The skull seems to be quite like that of the typical *fontanierii* except for its smaller size, that of the largest male not reaching the size of adult examples of females of the latter. A comparison of the teeth indicates that the enamel pattern is essentially the same, but the size of the teeth is markedly less. Also the notch formed by the posterior borders of the nasals is shallower.

Measurements.—The following external measurements were taken in the field by the collector:

No.	Head and body	Tail	Hind foot	Sex	Locality
144022 USNM	205	55.0	36.0	♂	Kansu
37856	174	65.5	31.0	♂	Kansu
155175 USNM	180	58.5	32.0	♂	Kansu
155176 USNM	189	57.5	31.0	♂	Kansu
155177 USNM	160	52.5	29.0	Im. ♂	Kansu
155088 USNM	167	61.0	30.0	♂	Kansu
32297	175	41.0	29.0	♀	Kansu
155174 USNM	172	54.0	27.0	♀	Kansu
155083 USNM	175	58.0	28.0	♀	Shensi
155086 USNM	175	57.0	29.5	♀	Shensi

For cranial measurements, see table under *M. f. fontanierii*.

Nomenclature.—On bringing together the available material representing the genus *Myospalax* from China, it is evident that there is much individual variation in many characters, the skulls of scarcely any two being quite alike. This has been shown by Lönnberg (1926), who pointed out not only that the occasional specimens with more tapering rostrum or evenly outlined nasals occur in the same localities as those having the outer border of the nasals pinched in subterminally, but also that if this is used as a basis of specific division, we must have two distinct species living side by side and differing only in the minute degree of taper and outline of the snout. He also pointed out that there is much variation in the tooth pattern of individuals from the same place, some showing a shallow second internal reëntrant on the last upper molar, as in the case of *M. fontanierii*, while others lack it. There are also minor differences in the form of its postero-external lobe. All this is as one might expect, and is true of other genera, as for example *Microtus*. With a series of *Myospalax f. cansus* from the same locality before me, and undoubtedly representing but a single species, there are numerous individual differences—as in the shape or taper of the nasals; the sharpness of the interorbital edges; the degree of divergence of the temporal ridges and their outline, whether straight or sinuous; in the presence or absence of a vertical crest in the middle of the posterior shield; in the vertical extent of the bullæ with respect to the basi-

occipital, and in the form of the basi-occipital itself. The variation in crest development is partly a matter of age, possibly of sex, but is largely individual and independent of age. These variations are no doubt in part conditioned by the muscle development, and in a species with such heavy neck and limb muscles would be expected to show differences in development. As Lönnberg writes, "When as well the skulls as the animals themselves are so similar and they have been collected at the same place, there is no other explanation of this fact except individual variation." The majority of specimens of mole-rats collected are not fully mature, but usually still have the basal suture open and the temporal ridges scarcely marked, but often low at the sides of the brain case and diverging, or in other specimens much closed together.

It is with some hesitation that I have included in the synonymy of *M. f. cansus* the species described in 1909 by J. A. Allen as *Myotalpa rufescens*. It was based on a single specimen from Taipai Shan, southern Shensi, but the skull lacked the occipital region and most of the palate. In color characters it is said to be darker and more rufescent than *M. f. cansus*, with more heavily haired tail and feet. These characters are, however, subject to a considerable latitude of individual variation, some specimens being nearly all dark gray, others uniformly rufescent. The lack of a white forehead mark is common to *M. f. cansus* as well; while the skull characters, so far as ascertainable—diastema, 13.5; height of lower jaw at the angle, 20—also agree. It is of course possible that, when large series can be brought together and minor local differences established, this name will become available for a locally restricted race, but this is not evident at the present time. The character of hairiness or hairlessness of the tail is a peculiar one. Ordinarily the hair is minute and scattered in both winter and summer specimens. In a January specimen from Fengsiang, however, the tail is well haired and the feet also. It seems to be true that the hairiness of these parts is greater in the more southern specimens, but there are numerous exceptions.

Occurrence and Habits.:—While specimens of this race are strikingly different in the size of skull and teeth when compared with the large examples from northern Shansi and Hopei representing the typical form, there can be little doubt that the two intergrade somewhere in Shensi, for in other respects their agreement is as close as usual in related races. I am therefore placing *cansus* as a subspecies of *M. fontanierii*, and include with it as a synonym Thomas's *M. c. shenseius* which A. B. Howell (1929) has shown offers no distinctive characters, its supposed longer tooth row and "warmer" color proving to be inconstant. The type locality of this latter is Yulinfu, Shensi.

The range of this smaller race apparently extends from about central Shensi westward to the borders of Koko Nor in western Kansu. No certain record of

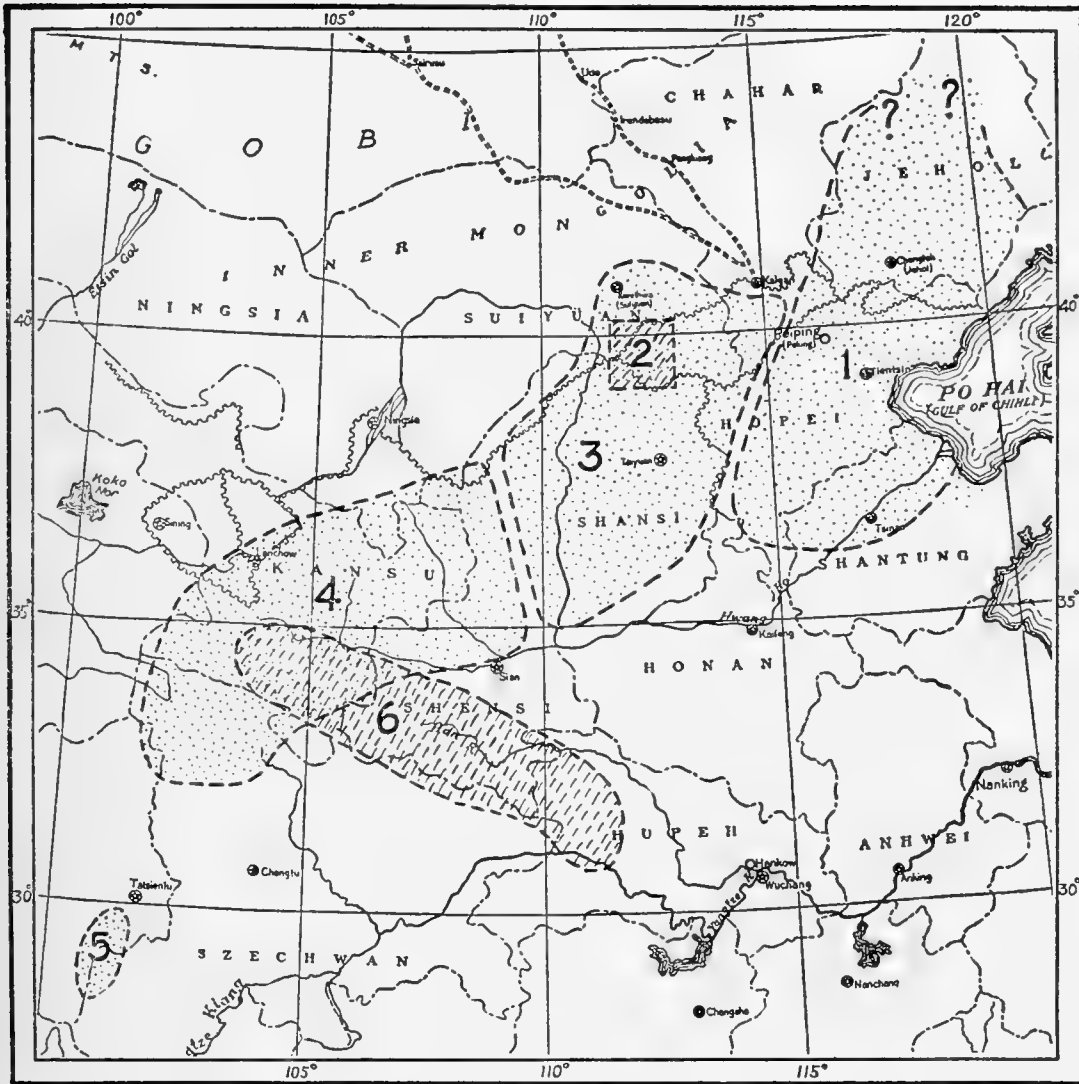


FIG. 45. Distribution Map.

Myospalax

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|---------------------------------|--------------------------------------|----------------------------------|
| 1. <i>M. myospalax psilurus</i> | 3. <i>M. fontanierii fontanierii</i> | 5. <i>M. fontanierii baileyi</i> |
| 2. <i>M. armandii</i> | 4. <i>M. fontanierii cansus</i> | 6. <i>M. rothschildi</i> |

it has been made south of the Min Shan of southern Kansu, beyond which it is replaced by the smaller species with short hairy tail. Both Thomas and A. B. Howell include with this race specimens from Yeninfu in northern Shensi, and others from Yulinfu in the central part of the province. Both these writers include other records from ten miles south of Taochow, fifteen miles southeast of Choni, fifteen miles northeast of Chingning, thirty miles south of Lanchow, and near Archuen, Min Shan. Most of these specimens I have seen. All the

localities are in southern and eastern Kansu, where apparently the animal is common. What is perhaps the most western record was made by Buechner (1892), who, however, referred his specimens to *Siphneus fontanieri*. One of these was taken close to the border of Koko Nor near Donkyr by Potanin's expedition of 1884-87; the other was a picked-up skull from Quaternary strata not far from Minchow. The northward range is still unknown.

Mr. Arthur de C. Sowerby (Clark and Sowerby, 1912) has some interesting notes on this species as found by him in a journey across Shensi and into Kansu. He states that it "seldom comes above ground, but that it does so occasionally may be gathered from the fact that I have found its remains in owl pellets. The Chinese peasants declare that by watching the mouth of a mole-rat's burrow they can foretell the weather. The burrows, they say, are left open when fine weather may be expected, and closed before the advent of rain."

M. P. Anderson (in Thomas, 1909) notes that it is rather common, and that traces of it, old or new, were found in nearly every field of those parts of Shensi visited, but it is difficult to trap, and must usually be dug out. "In walking on the surface of the ground the rodent-mole turns the long claws of the fore-feet under the soles and walks upon the backs of the claws," a posture very well shown by Sowerby's plate 48 (Clark and Sowerby, 1912). Anderson adds further, that "when frightened or angered this animal utters a peculiar little squeal. . . ." The Chinese name is said to be "ha-whei" or "ha-lao," or again "hsia-lao," meaning the "old blind one" or the "blind gray one."

To the south this race doubtless grades into *M. f. baileyi*, for a single skin, without skull, was collected November 26, 1931, by the Brooke Dolan West China Expedition at a locality one day south of the Tsagu Mountains of northern Szechwan that might well be regarded as intermediate. Though from its dark gray color, only slightly tipped with drab and russet, and its rather small size, it is doubtless immature, the tail is short (35 mm. or so in the prepared skin) and hairy, although the season may have something to do with this feature. The fore feet have large claws as in *M. f. cansus* and are minutely haired to the bases of the terminal phalanges. There is no white blaze on the forehead, but the muzzle is narrowly white along the upper edge of the mucronate nose-pad. The specimen is in the collection of the Academy of Natural Sciences of Philadelphia.

Specimens examined:—The following fifty-two:

Shensi: forty-five miles south of Fengsiangfu, 1; Yulinfu, 5 (U.S.N.M.), 18 (B.M.); Yeninfu, 1 (U.S.N.M.), 2 (B.M.); Taipai Shan, 1 (type of *M. rufescens*).

Kansu: fifteen miles northeast of Chingningchow, 1, plus 8 (U.S.N.M.); Choni, 4 (M.C.Z.), 1 (U.S.N.M.); Lanchow, 4 (U.S.N.M.); Taochow, 5 (U.S.N.M.).

Szechwan: one day south of Tsagu Mountains, 1 (A.N.S.P.).

403. *Myospalax fontanierii baileyi* Thomas

Myospalax baileyi Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 8, p. 727, 1911.

Type specimen.—An adult female, skin and skull, No. 11.10.3.6, British Museum, from Ramasong, between Nagchuka (or Hokow) and Tatsienlu, western Szechwan, China. Collected May 21, 1911, by Captain F. M. Bailey.

Description.—The single known specimen is described as similar to *M. f. cansus* in general, but the tail shorter and the feet more hairy. The latter trait is, however, probably in part a seasonal matter, for at the early date, May 21, mammals at the altitude of these high passes would still be in winter pelage. Color gray with scarcely any drabby tinge, therefore "markedly grayer than in *cansus*"—although be it noted that immature animals of the latter are much grayer than adults. Below slaty, washed with very pale drab. Crown of head darkened, as usual in this group, and a small white patch present at the end of the muzzle. Hands and feet white, closely hairy to the bases of the claws, which are proportionally large. Tail unusually short, little longer than hind foot, white throughout.

The skull is essentially as in *M. f. cansus*, but the nasals surpass the premaxillæ behind instead of ending on the same transverse plane, and have a noticeable expansion about half-way on their length. The temporal crests approach each other more closely behind than they do at the fronto-parietal suture, a character, however, sometimes found in *M. f. cansus*, although in immature animals at least, the ridges usually diverge posteriorly.

The teeth are similar to those of *M. f. cansus*, except that the last upper molar is larger and has a fairly deep reëntrant angle on the postero-external lobe between the two projecting angles of its outer side, and a shallow reëntrant angle on its inner side, making in all two inner reëntrants and three outer. Similar variations occur, however, in the northern forms of the species.

Measurements.—The type measured in the flesh: head and body, 173 mm.; tail, 33; hind foot (probably without claws), 26.

The cranial measurements are given in the table under *M. f. fontanierii*.

Occurrence and Habits.—As stated by Thomas, this was the first record of the genus from Szechwan, and at the same time the most southerly known. No doubt, however, the high altitude of the area where it occurs compensates for any southerly latitudinal difference. In external appearance this is closely similar to the race *M. f. cansus* with which it doubtless intergrades, so that I have ventured to regard it as only subspecifically different. The shorter tail is perhaps distinctive, but its greater hairiness is possibly a seasonal trait of winter. The cranial dimensions are not very different, and the peculiarities described for the enamel pattern of m^3 are subject to some variation.

The locality of the type, Ramasong, between Nagchuka and Tatsienlu, is high alpine country on the borderland of the Tibetan plateau. Nothing further is known of the animal.

It is possible that the intermediate specimen just mentioned under *M. f. cansus*, from northern Szechwan, would be more properly referable to *M. f. baileyi*, but this is not at present possible to determine.

Specimens examined:—One, the type, from Ramasong, Szechwan (B.M.).

404. *Myospalax rothschildi* Thomas

Myospalax rothschildi Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 8, p. 720, 1911.

Myospalax fontanieri G. M. Allen, Mem. Mus. Comp. Zool., vol. 40, p. 209, 1912 (not of Milne-Edwards).

Myospalax minor Lönnerberg, Arkiv f. Zool., Stockholm, vol. 18A, no. 21, p. 6, 1926. Archuen, Kansu.

Type specimen:—An adult male, skin and skull, No. 11.11.1.2, British Museum, from forty miles southeast of Taochow, Kansu, China, altitude 11,000 feet. Collected April 11, 1911, by Dr. J. A. C. Smith.

Description:—In general outward appearance this species resembles *M. f. cansus*, but is obviously smaller in all its dimensions, with much lighter claws and shorter tail, which, like the backs of the feet, is thickly hairy. In the specimens at hand there is no white blaze on the forehead, and the shape of the nose-pad, though difficult to determine in dried condition, seems to differ in having the vertical median point much better marked, giving the upper border of the pad a trifoliate appearance.

Fur of the fine silky texture usual in the genus; nose-pad and edges of the lips may be bordered with white, but the white blaze on the rostrum and on the occiput seems to be lacking. The head from muzzle back to the level of the eyes is clear gray as seen from in front, and may be darker or lighter, apparently depending on whether the specimen is more immature or more nearly adult. The rest of the body above and below has the bases of the hairs slaty gray, and in the brighter phase the extreme tips are bright pinkish buff. Tail well-haired, bicolor, gray above and white beneath. Backs of the feet well covered with whitish hairs.

The widespreading zygomata and small teeth were pointed out by Thomas as the chief distinguishing features of the skull, in addition to its smaller size. The former character, however, varies individually, and is apparently no more pronounced than in some specimens of *M. f. cansus*. In the size and heaviness of their teeth the males seem slightly to exceed the females. One individual of two from Hupeh has the brain case much higher, more arched than the other, but it is slightly younger and a female, while the other is a male. Both agree in having the nasal border notched behind and exceeded by the backward extension of the premaxillaries, but in a third from Kansu the nasals and pre-

maxillaries end evenly on the same transverse line. A similar variation is shown in the skulls of *M. f. cansus*. The continuation of the outer edge of the antorbital plate as a ridge on to the ventral surface of the rostrum is not very well marked in the immature specimens, but present none the less. The palate ends in a well-developed median spine, but this is true also of *M. f. cansus* in most cases. The incisive foramina vary in length and narrowness in individuals of both species. The size of the skull and the tooth rows seems to be the only trenchant character for distinguishing the crania, while externally size and hairiness of the shortened tail are perhaps the most obvious differences. One might almost incline to regard *M. rothschildi* as a subspecies of *M. fontanierii* were it not that hitherto no series of intergrades has been found connecting it through the smaller *M. f. cansus*, while in southern Kansu both species occur practically together. They are at all events closely related.

In the type specimen the third upper molar shows a posterior shallow re-entrant on the inner side, and Howell (1929) notes its presence in the skulls from Taochow in the U. S. National Museum. Lönnberg (1926) has figured these teeth in three specimens from Archuen, which he refers to a new species, *M. minor*. The second re-entrant in an adult male is present on one side only, and in an adult female is very shallow on one side, while in a third immature specimen it is present on both sides, though unequally developed.

Measurements.—The following flesh measurements are available:

No.	Head and body	Tail	Hind foot	Sex	Locality
II.11.1.2 BM (type)	164	45 (?)	26	♂	Kansu
7131 MCZ	155	35	27	♂	Hupeh
7130 MCZ	155	38	31	♀	Hupeh
I44023 USNM	147	33	28	♀	Kansu
I44024 USNM	160	30	27	♀	Kansu
I44025 USNM	157	31	29	♀	Kansu
I44026 USNM	150	29	28	♀	Kansu

CRANIAL MEASUREMENTS OF *MYOSPALAX ROTHSCILDI*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Width of occipital plate	Width outside molars	Upper cheek teeth	Lower cheek teeth	Locality
60420	38.0	33.8	20.5	—	—	7.8	7.5	7.8	Kansu
II.11.1.2 BM	39.7	35.2	21.7	27.8	23.3	8.0	7.7	7.7	Kansu
7130 MCZ	36.2	31.7	20.6	24.3	21.0	8.5	8.6	8.7	Hupeh
7131 MCZ	38.7	34.4	22.0	26.5	21.7	9.2	9.1	9.7	Hupeh
I44023 USNM	37.1	31.5	20.7	21.5	21.1	8.0	8.3	8.3	Kansu
I44024 USNM	37.6	33.0	21.4	23.1	22.4	8.5	8.5	8.6	Kansu
I44025 USNM	38.5	33.3	21.5	23.1	21.7	8.6	8.6	8.9	Kansu
I44026 USNM	36.1	33.8	—	—	—	—	8.1	9.1	Kansu
I44027 USNM	39.5	34.5	22.2	24.4	23.2	8.8	8.6	9.3	Kansu

Occurrence and Habits.—This small species is characterized by its slender, light claws, its short and thickly haired, bicolor tail, the paler russet color and usual lack of white forehead mark, and by its generally lesser size, as distinguished from the forms of *M. fontanierii*. The nose-pad seems also to be more mitre-shaped, with the median point more prolonged upward. The skull is essentially like that of the latter species except for its smaller size, with correspondingly small teeth, and its less-developed ridges. The fact that the range seems to overlap the more southern part of the range of *M. fontanierii cansus*, so that in southern Kansu the two occur practically together, indicates that they are distinct species rather than races of a single one. But few specimens have been recorded. The type came from forty miles southeast of Taochow, southern Kansu, and A. B. Howell in 1929 recorded five skulls and four skins from Taochow itself, remarking at the same time on the anomaly of having so many species represented at that place. But with the relegation of Lönnberg's *M. minor* to the synonymy of *M. rothschildi*, the problem becomes simplified, for the main difference of *M. minor*, type locality Archuen, southeastern Kansu, lay in the less widely bowed zygomata, a character which proves to be variable, as shown by specimens otherwise similar from a single locality. The usual presence of a shallow posterior reentrant on the inner side of the last upper molar, while not peculiar to this species, seems nevertheless more common than in the larger species. Besides the specimens mentioned, the only others known to me are a single one from Archuen collected by the American Museum Asiatic Expeditions, and the two small specimens from western Hupeh (Hongchikou and Showlungtan), which in my paper of 1912 I recorded as *M. fontanieri*. These are the most southeastern specimens of the genus yet recorded, but in all essentials seem to be identical with *M. rothschildi*, the range of which thus extends over a wide east-west area from western Hupeh to central southern Kansu. Nothing is recorded of the habits or habitat.

While there is a possibility that more than one local race will eventually be found recognizable, the very few specimens at present in collections are insufficient to establish this. The Hupeh specimens have slightly more delicate claws than those from Kansu, but the difference is slight, and they are otherwise similar. In the type the longest fore claw measured from the edge of its sheath is 9.5 mm., against 12.7 in *M. f. cansus*.

Specimens examined.—In all, nine, as follows:

Hupeh: Hongchikou, 1; Showlungtan, 1 (both M.C.Z.).

Kansu: Archuen, 1; forty miles southeast of Taochow, 1, the type (B.M.); Taochow, 5 (U.S.N.M.).

405. *Myospalax smithii* Thomas

Myospalax smithii Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 8, p. 720, 1911. A. B. Howell, Proc. U. S. Nat. Mus., vol. 75, art. 1, p. 55, 1929.

Type specimen.—An adult male, skin and skull, No. II.II.I.I, British Museum, from thirty miles south of Taochow, Kansu, China. Collected by J. A. C. Smith, April 6, 1911.

Description.—Externally this species much resembles *M. fontanierii cansus* with which it seems to be associated, but the tail is shorter, little or not exceeding the hind foot in skins, and more thickly clothed with short hair. In the type, which is adult, the fore part of the head back to the ears is velvety blackish, shading into dark blackish brown over the back, all the hairs minutely tipped with cinnamon. The chin is drab, the throat slaty gray, the belly the same, washed with cinnamon. In immature pelage the head is sooty and the rest of the body a uniform bluish gray, the hairs somewhat paler at their tips. A small white area of variable size may extend a short distance back from the upper border of the nose-pad.

The cranial characters of the adult seem to be the chief distinguishing feature. As compared with *M. fontanierii cansus* of the same province, Kansu, the orbit, instead of having its upper anterior edge roofed over and the inter-orbital edge angular forcing the temporal ridges to extend straight back parallel with each other to the lambdoid crests, has its edges rounded, with almost no overhang, so that the temporal muscles extend dorsally, meeting in the middle of the interorbital region, and thence extending back on the midline. The temporal ridges, instead of being far apart, are thus approximated medially, forming a median crest in old age, while in younger animals they nearly meet at the junction of frontal and parietal to enclose a narrow triangular area in the region of the interparietal. The brain case is not so high in *M. smithii*, and the nasals usually differ in having their posterior ends nearly transverse or tapering medially, instead of forming a notch, convex forward. The nasals appear to be slightly longer, extending at least as far back as the tips of the ascending processes of the premaxillæ, instead of being slightly shorter. The teeth are similar in both, but the tooth rows of *M. smithii* are usually a little more divergent posteriorly. Finally, a marked difference lies in the situation of the incisive foramina: in *M. f. cansus* the posterior boundary of the premaxillaries forms a transverse suture extending quite to the middle of the foramina, so that their posterior half lies in the maxillaries, while in *M. smithii* a narrow tongue of the premaxillary extends back from the suture to encompass the hind end of these openings, much as in *M. myospalax*.

Measurements.—Two specimens in the U. S. National Museum were measured in the flesh as follows:

No.	Total length	Tail	Hind foot (c. u.)	Locality
240750	185	37	32	Kansu
240752	207	39	34	Kansu

Both are immature, but show how short the tail is relative to the hind foot.

The skull of the type and a few other younger specimens show the following dimensions:

CRANIAL MEASUREMENTS OF *MYOSPALAX SMITHII*

No.	Greatest length	Basal length	Palatal length	Zygomastic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
11.11.1.1 BM (type)	49.5	45.7	27.0	34.4	30.0	10.5	10.4	10.4	Kansu
12.8.5.58 BM	44.9	40.2	25.7	29.5	26.1	10.4	9.3	9.8	Kansu
240899 USNM	44.5	39.7	25.5	—	26.9	9.7	9.8	10.1	Kansu
240750 USNM	43.4	37.7	24.2	28.3	26.8	9.6	9.6	9.8	Kansu

Occurrence and Habits.—It is remarkable that there should be in Kansu two species of mole-rat so similar in external appearance as this and *M. f. cansus*, occurring apparently in the same general region yet maintaining their distinctness. *M. smithii* appears to be a shorter-tailed animal, while the skull is distinctive in having the temporal ridges that mark the upper boundaries of the temporal muscle meet over the orbits and in age form a sagittal crest, whereas in the other species they continue back from the angle of the interorbital plane to form parallel ridges that fail to meet medially. Immature animals show this same difference except that the ridges are less marked, and there are other details that make the distinction fairly clear.

Although not described until 1911 from a specimen collected by J. A. C. Smith thirty miles southeast of Taochow, Kansu, it seems to have been taken slightly earlier by G. Grum-Grzmailo, who obtained it at Gumansa, Kansu. One of his specimens is in the British Museum, but has only the rostral portion of the skull with enough of the interorbital region to show the upward extension of the muscle scars. In addition to these, Lönnberg (1926) recorded two large specimens from Min Shan, western Kansu, and A. B. Howell (1929) makes note of others from the same province. These latter, in the collection of the U. S. National Museum, are: one from Choni, one from thirty miles east-southeast of Lanchow, and one one hundred and twenty miles south of that city; none of these is adult.

This species, if such it be, offers somewhat of a puzzle, living in apparently the same country with *M. f. cansus* and *M. rothschildi*, and differing only in cranial characters of a peculiar sort. I am inclined to regard it as a hybrid between the *M. f. cansus* and a race of the *M. myospalax* type, which, having become cut off in this area through the advance of the desert and meeting the range of the former, has more or less completely amalgamated with it. The intermediate character of the incisive foramina and of the temporal crests and muscle scars is perhaps indicative of this.

Specimens examined:—The following six:

Kansu: thirty miles southeast of Taochow, 2, including the type (B.M.); Gumansa, 1 (B.M.); thirty miles east-southeast of Lanchow, 1 (U.S.N.M.); one hundred and twenty miles south of Lanchow, 1 (U.S.N.M.); Choni, 1 (U.S.N.M.).

Family MURIDÆ

TYPICAL MICE AND RATS

In older classifications it was customary to include in this family the cricetine rodents, making of them a subfamily Cricetinae and of the more typical murids a subfamily Murinae. Miller and Gidley (1918), however, have very properly raised the latter group to the rank of a distinct family, characterized by the tubercular pattern of the molars. In their view, there has been added to the cricetine pattern of paired cusps a third row of functional tubercles on the inner side of the upper molars, and in some species a corresponding row on the outer side of the lower molars. There are thus in the upper teeth three lengthwise rows of rounded cusps, which tend to coalesce into three transverse rows as well, and in extreme development these rows become vertically drawn out to form laminae. Hinton (1926), after a special study of the molar structure, regards the underlying pattern as similar in both groups in its more primitive state, as seen, for instance, in the Nesomyinae of Madagascar, with three lengthwise rows of tubercles, of which in the cricetines the median row has suffered reduction and the lateral rows have become dominant, whereas in the murines the median row has become excessively developed, more or less at the expense of the lateral rows. He agrees with Forsyth Major in believing that the Allotheria or Multituberculata may be regarded as the ancestors of the modern simplicidentate rodents, and that their molar pattern is a direct heritage from that of those ancient forms. This attractive theory accords with the apparently ancient origin of the rodents, a group which in nearly modern form goes back into secondary times and may even have reached Australia with the marsupial fauna now predominant there, before that continent was cut off from the other land masses, probably in late Cretaceous times. As at present understood, no murid has more than three cheek teeth in each jaw (though some have but two), thus paralleling the Cricetidae. These teeth are short-crowned in most species, and rooted. The anteriormost is interpreted by Hinton as a persistent milk molar, the two others as true molars.

As a family the Muridae are confined to the Old World, except as introduced by man within recent times, and are most abundant in the tropics and subtropics, becoming scarce in colder or even temperate regions. The members of this family have shown great power of adaptation to different types of environment, most of them terrestrial, but with climbing and arboreal forms, others to some extent burrowers, and some partly aquatic. Of the five sub-

families listed by Miller and Gidley, only one, the typical Murinæ, is known from the area under discussion. In this group the upper teeth have the "fully developed triserial arrangement of tubercles always evident, though frequently varying from the symmetrical plan; crowns brachyodont or slightly hypsodont; manus normal," though in some of the climbing genera the first toe of the hind foot may have a flat nail instead of a claw and may even be more or less opposable to the rest of the foot. The group includes the ordinary rats and mice, such as those that are commensal with man, and as with the Cricetidæ these often become very abundant in the presence of favorable conditions, including a plentiful supply of food and immunity from enemies and disease. They are therefore of much economic importance as competitors with man and other animals for vegetable food, while as carriers of fleas that act as intermediate hosts for certain diseases, such as bubonic plague, some of the species are of interest from a medical standpoint. Although the number of genera represented in China and Mongolia is not large—hardly more than a half dozen—the number of species is proportionally great, especially in the genus *Rattus*, which as at present restricted is almost wholly Asiatic and European, except as artificially introduced outside that area. No doubt in time some of the various subgroups, even of this genus, will be given generic standing as they become better understood.

The following key indicates the genera of Muridæ at present known from China and Mongolia.

KEY TO THE GENERA OF CHINESE AND MONGOLIAN MURIDÆ

- A. First digit of hind foot with a claw; not opposable.
 - a. Small mouse-like species, hind foot 25 mm. or less.
 - a'. First upper molar of three cross-ridges, each with three tubercles, making three on the inner border of the tooth.
 - a''. Ears normal, reaching when laid forward at least to the eye; tail not naked at the tip above, rostrum of skull not noticeably short *Apodemus*
 - b''. Ears short, reaching when laid forward only about half-way to the eye; tail prehensile, naked above at the tip; rostrum of skull noticeably short. *Micromys*
 - b'. First upper molar with the third of its three cross-ridges having only the two outer tubercles well developed, making but two on the inner border of the tooth.
 - a''. Rostrum normal, the distance from the anterior base of the zygomatic plate to the gnathion exceeding the width across molars. *Leggada*
 - b''. Rostrum shortened, the distance from the anterior base of the zygomatic plate to gnathion less than the width across molars. *Mus*
 - b. Larger, rat-like species, hind foot 30 mm. or more.
 - a'. Upper molars with the tubercles of the cross-ridges distinct, each cross-ridge of the first molar nearly a trefoil. *Rattus*

KEY TO THE GENERA OF CHINESE AND MONGOLIAN MURIDÆ (Cont'd)

- b'. Upper molars with the tubercles of the cross-ridges not distinct, but fusing together to form transverse laminae, with a forward convexity. *Bandicota*
- B. First digit of hind foot with a flat nail; opposable.
 - a. Upper incisors slightly grooved; molars much as in *Rattus*, with the usual transverse rows of tubercles. *Vandeleuria*
 - b. Upper incisors not grooved; upper molars not like those of *Rattus*.
 - a'. Central cusps of upper molars forming a longitudinal ridge; lower molars with cusps in transverse pairs. *Chiropodomys*
 - b'. Central cusps of upper molars not forming a longitudinal ridge; lower molars with cusps in transverse rows of three. *Hapalomys*

Genus *Apodemus* Kaup

Apodemus Kaup, Entwickl.-Gesch. u. Natürl. Syst. Europ. Thierwelt, vol. 1, p. 150, 1829.

Mus Barrett-Hamilton, Ann. Mag. Nat. Hist., ser. 7, vol. 6, p. 387, 1900; and other authors, in part.

The mice of this genus are small, about the size of a house mouse or slightly larger, with no special modifications externally. The ears are well developed and nearly bare, as in the latter, the feet elongate, the tail of moderate length, in some species slightly less than head and body length, in others slightly exceeding it, non-prehensile and thinly haired so that usually it is possible to see the rings of scales plainly. The chief distinguishing characteristics lie in the skull and teeth. The rostrum is not disproportionally short, but is rather long, with the diastema obviously longer than the depth of the skull at the first upper molar. The molars preserve the three rows of three cusplets each in a less modified condition than in most members of the family; both the first and second upper molars retain three cusps on the inner side, and the first lower molar has three minute cusps on the outer side as well. In the second upper molar the anteriormost of the three external cusps is lost in some species.

The many species fall readily into several "groups" which have been given the rank of subgenera, but the characters are not so unvarying as to be of greater value. These groups have been defined by Thomas (1924a) and others as follows:

Skull rounded and smooth, with flat or concave forehead, last upper molar trifid on its inner side, second upper molar with a minute antero-external cusplet; $mamm\ae\ 2-2=8$, or $1-2=6$. . . Subgenus *Sylvæmus* Ognev and Vorobiev.

Skull compressed, ridged and convex upward, last upper molar bifid on its inner side, second upper molar lacking the small antero-external cusplet; $mamm\ae\ 2-2=8$. . . Subgenus *Apodemus* Kaup.

The two subgroups differ somewhat in their habits, the former being rather more confined to woodlands where it occupies much the same ecological niche

as does *Peromyscus leucopus* in North America, to which also it bears much external resemblance, notwithstanding that the two belong to different families. The members of the subgenus *Apodemus* are probably more partial to less-wooded areas, with slightly more arvicoline habits, and hence are often spoken of as field mice rather than wood mice. As a genus these small creatures are highly characteristic of the temperate portions of the Palæarctic region, abounding from western Europe to Japan, and south to northern Africa, the Mediterranean region, and across central Asia to mid-China.

For a minute account of the characters of the European species, see G. S. Miller, Jr., 1912.

The species and subspecies recognized as occurring in China may be identified by the following key.

KEY TO THE CHINESE AND MONGOLIAN FORMS OF *Apodemus*

- | | |
|---|---------------------------------|
| A. Skull smooth, forehead somewhat flattened or slightly concave; last upper molar with three inner lobes. | Subgenus <i>Sylvæmus</i> |
| a. Ears blackish or blackish brown, contrasting with the color of neck and body. | |
| a'. Smaller, hind foot less than 21 mm., ears less than 19 mm. in length. | |
| a''. Ankles white, tail longer than head and body, dorsal coloring deep and dull. | <i>A. sylvaticus orestes</i> |
| b''. Ankles dark, tail about equaling head and body, dorsal coloring brighter. | <i>A. sylvaticus draco</i> |
| b'. Larger, hind foot about 25 mm., ears 19-21 mm. in length. . | <i>A. latronum</i> |
| b. Ears ochraceous like the surrounding parts of the neck and sides. | <i>A. peninsulae</i> |
| B. Skull with pronounced supraorbital ridge, forehead slightly convex; last upper molar with only two inner lobes. | Subgenus <i>Apodemus</i> |
| a. Without a distinct black spinal stripe. | |
| a'. Color richer, ochraceous evenly mixed with black. | <i>A. agrarius chevrieri</i> |
| b'. Color duller, with an indistinct to fairly well-defined blackish dorsal stripe. | <i>A. agrarius ningpoensis</i> |
| b. A sharply marked narrow spinal stripe of black. | |
| a'. Color of the sides and back brighter. | <i>A. agrarius mantchuricus</i> |
| b'. Color of back and sides paler, with pale shoulders. | <i>A. agrarius pallidior</i> |

Subgenus *Sylvæmus* Ognev and Vorobiev

Sylvæmus Ognev and Vorobiev, Fauna of the Terrestrial Vertebrates of Govt. of Voronesh, separate publ., p. 143, 1923 (?), 1924?. (Type, *Apodemus sylvaticus*.)

Nemomys Thomas, Journ. Bombay Nat. Hist. Soc., vol. 19, p. 889, May 15, 1924.

Ognev and Vorobiev's name *Sylvæmus* seems to have been proposed as a genus for the common species of Europe, *Apodemus sylvaticus*, slightly before Thomas's *Nemomys* as a subgenus with the same type, and hence the latter

becomes a synonym. Thomas points out that the members of this subgroup fall into two lots, those with eight and those with six mammae, but that such a distinction is not in all cases a satisfactory criterion of relationship. Members of both groups occur in China.

406. *Apodemus sylvaticus orestes* Thomas

Apodemus speciosus orestes Thomas, Abstract Proc. Zool. Soc. London, October 24, 1911, p. 49; Proc. Zool. Soc. London, 1912, p. 136. Osgood, Publ. Field Mus. Nat. Hist., zool. ser., vol. 18, p. 317, 1932.
Apodemus sylvaticus draco G. M. Allen, Mem. Mus. Comp. Zool., vol. 40, p. 220, 1912 (not of Barrett-Hamilton).
Apodemus ilex Thomas, Ann. Mag. Nat. Hist., ser. 9, vol. 10, p. 404, 1922; Journ. Bombay Nat. Hist. Soc., vol. 29, p. 889, 1924. Mekong-Salween divide, Yunnan.

Type specimen.—An adult male, skin and skull, No. 11.2.1.170, British Museum, from Omei Shan, Szechwan, China. Collected August 18, 1910, by Malcolm P. Anderson.

Description.—A slender, dark brownish-fulvous mouse, with blackish ears, and tail slightly longer than head and body.

General color of the head and body above, dull ochraceous, heavily lined with black hairs which tend to be more numerous on the lower back medially, darkening that area. At the sides of the body and along the posterior part of the cheeks and on the fore limbs, the admixture of black hairs becomes much less, and the color correspondingly clearer ochraceous. The exposed parts of the ears, both inside and out, are contrastingly blackish brown, with a small tuft of similarly colored hairs covering the anterior base. The feet to the wrists and ankles are pure white, thinly haired. Lower surface of the body and limbs including the lips, covered with gray-based hairs tipped with white. On the throat and chin the gray bases show through more or less, and to some extent over the belly as well. A spot of ochraceous may be present in the middle of the chest, of greater or less extent lengthwise, but it is often lacking, while occasionally the whole lower surface may show a faint tinge of the same. Tail bicolor, blackish above, whitish below, sharply marked, but the hairs so minute that usually the rings of scales are clearly seen.

Specimens in winter pelage tend to be somewhat brighter ochraceous, and the white tips of the hairs on the under side, being longer, tend to make the belly appear whiter and less gray.

The skull is not very different in its details from that of the European *A. sylvaticus*, having a long, slender rostrum, a well-rounded brain case, with in adults a low line of beading from the orbits back more or less clearly to the anterior corner of the parietal, then less distinct, but sometimes traceable to the posterior angle made by the squamosal. The nasals are very slightly longer than in European races, equaling and sometimes slightly exceeding the premaxillae in posterior extent. In ventral aspect the incisive foramina reach the level of the anterior edge of the first molar. The posterior border of the

palate is continued a very short distance back of the last molars, and ends usually in a blunt median projection instead of being arched, the more usual condition in European specimens.

The teeth are quite as in the typical *A. sylvaticus*. The first molar is almost as long as the combined length of the two others, and has a median row of three larger tubercles, each of which is continuous laterally with an inner and an outer one of smaller size, the former, however, slightly behind the transverse plane of the latter. In addition there is a very minute postero-external cusplet. The plan of the second molar is similar, but the middle one of the first transverse row of tubercles has disappeared, and its two lateral cusps are very small. The third and smallest tooth is so much reduced that the homologies of its cusps are less clear, but it has two outer and three inner cusps or lobes.



FIG. 46. Left upper molar row of *Apodemus sylvaticus orestes* (left); *Apodemus peninsulae* (center); and *Apodemus agrarius chevrieri* (right), showing three inner lobes to the last molar in the two first species, and but two in the last; the reduced inner cusp of the third transverse row in m1 in *A. peninsulae*; the extra external cusp in m1 in *A. a. chevrieri*, and the lack of an antero-external cusp in m2 in both this and *A. peninsulae*. Much enlarged.

In the first lower molar there are three pairs of main cusps, with a minute median cusp at the front and another at the back of the tooth, while externally there are two or three lower and ledge-like cusps. The second tooth is similar but lacks the anterior median cusplet and first pair of larger cusps, while the third is more nearly circular in outline, and consists of an anterior pair of main cusps with a single large median cusp posteriorly. The pattern is described thus at length for comparison with that in other species later mentioned. The incisors, as usual, have their points evenly beveled off to a chisel edge.

Measurements.—The long, thinly-haired tail is rather more than the combined length of head and body. The ears, on the other hand, as in the European forms, are not particularly large, much smaller proportionally than in the American wood mice (*Peromyscus*). The following collectors' measurements were taken from fresh specimens in the field:

No.	Head and body	Tail	Hind foot	Ear	Locality
43593	88	105	24.0	18.0	Yunnan
43654	95	102	23.0	17.0	Yunnan
43656	98	105	23.5	18.5	Yunnan
43665	90	103	23.5	18.0	Yunnan
43671	92	103	23.0	—	Yunnan
43709	86	100	23.0	17.0	Yunnan
43724	90	104	24.0	18.0	Yunnan
43725	93	104	23.0	17.0	Yunnan
43727	102	115	24.0	17.0	Yunnan
43780	97	110	24.0	17.0	Yunnan
7627 MCZ	94	104	25.0	—	Szechwan
7629 MCZ	84	102	25.0	—	Szechwan
7633 MCZ	94	113	24.0	—	Szechwan
7663 MCZ	93	102	23.5	—	Szechwan
7660 MCZ	93	102	24.0	—	Hupei
11.2.1.170 BM (type)	93	125	24.0	—	Szechwan

CRANIAL MEASUREMENTS OF *APODEMUS SYLVATICUS*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width outside molars	Upper cheek teeth	Lower cheek teeth	Locality
<i>A. sylvaticus orestes</i>									
43702	25.3	20.2	11.9	12.5	11.5	5.1	3.8	4.1	Yunnan
43718	26.5	21.8	13.2	12.5	12.3	5.3	4.0	4.1	Yunnan
43725	25.8	21.9	12.7	11.5	11.5	5.3	3.9	4.4	Yunnan
43759	26.0	21.9	13.1	11.5	11.5	5.3	4.0	3.9	Yunnan
43180	26.6	21.7	13.0	12.5	12.0	5.1	3.8	3.8	Yunnan
7139 MCZ	26.2	21.0	12.7	11.2	11.5	5.1	4.1	4.0	Hupei
7627 MCZ	26.5	21.7	13.2	11.5	11.8	5.2	3.9	4.0	Szechwan
7628 MCZ	25.5	21.1	12.6	10.5	11.8	5.2	3.9	3.9	Szechwan
7660 MCZ	26.6	22.2	13.3	11.5	11.9	5.1	4.0	4.1	Hupei
7662 MCZ	26.0	21.5	12.8	11.5	11.8	5.4	4.0	4.0	Szechwan
7664 MCZ	26.6	21.7	13.2	11.6	11.5	5.2	4.1	4.2	Szechwan
7665 MCZ	26.7	21.5	13.1	11.9	12.2	5.5	4.2	4.4	Szechwan
7666 MCZ	26.2	21.0	12.6	11.5	12.1	5.4	4.0	4.5	Szechwan
7667 MCZ	26.5	21.4	12.7	11.2	11.8	5.5	4.1	4.2	Szechwan
7632 MCZ	28.0	23.3	13.8	12.5	11.8	5.5	4.1	4.4	Szechwan
11.2.1.170 BM (type)	27.2	22.7	14.0	—	12.1	5.6	4.3	4.3	Szechwan
<i>A. sylvaticus draco</i>									
98.11.1.20 BM (type)	—	—	12.6	11.7	—	4.7	3.8	4.0	Fukien
98.11.1.22 BM	24.1	20.0	11.8	10.5	11.0	5.0	3.7	4.1	Fukien
98.11.1.21 BM	24.5	19.7	11.7	—	10.4	4.9	3.7	4.2	Fukien
96.12.2.15 BM	26.0	22.1	13.7	—	11.4	4.9	3.8	4.0	Fukien
0.5.8.28 BM	26.4	21.7	13.0	—	11.3	5.2	3.8	3.7	Fukien
0.5.8.27 BM	24.5	20.7	12.6	10.5	11.2	4.9	3.7	3.8	Fukien
56434	26.6	21.8	13.6	12.6	11.3	5.3	3.7	3.7	Hopei
56438	27.8	22.6	13.3	13.2	12.3	5.5	4.2	4.1	Hopei

Nomenclature.—Although described as a race of a distinct species, this is but a slightly differentiated race of the *A. sylvaticus* group, of a rather rich dark coloring, and with a rather long tail. The character of having but six instead of eight mammæ, used by Thomas as a means of dividing the subgenus *Sylvæmus*, is in this race inconstant, for occasional specimens occur which clearly have the larger number. This possibly represents the retention of a primitive trait among the eastern members of the species. After a careful review of the series in the British Museum regarded by Thomas as representing his *A. ilex* and *A. sylvaticus orestes*, there remains no doubt whatever that the two are quite the same, so that, since the latter is the older name, *ilex* becomes a synonym of it. Evidently the mistake arose from Thomas's having supposed *A. sylvaticus orestes* to be a race of *A. speciosus*, so that he compared it only with *A. peninsulæ*.

Occurrence and Habits.—This race represents *A. sylvaticus* in western China. It is readily distinguished by its slender form, longer tail than head and body, the dark coloration, blackish ears and the blackish tuft at their anterior base. Its subgeneric characters are further diagnostic, with three inner lobes on the last upper molar, but with usually only one pair of pectoral mammæ instead of two, as in other Chinese species of the same subgenus. The dark ears are shared with the European *A. sylvaticus*, which, however, lacks the black tuft at their bases, and is more ochraceous instead of clay-color on back and sides.

This is an abundant species in the wooded parts of the Chinese highlands where, as before mentioned, it occupies the same faunal niche as does *Peromyscus* in North America though belonging to a different family. The most eastern record of its occurrence seems to be furnished by the small series secured by Walter R. Zappey for the Museum of Comparative Zoölogy in 1907. These came from Changyanghsien (8,000 feet), Fanghsien (8,500 feet), and Showlungtan, Hupeh, and were recorded by me (G. M. Allen, 1912, p. 220) as the subspecies *A. s. draco*. From the high country of western Hupeh, the range is doubtless continuous westward into western Yunnan, for Zappey secured a series from the following localities in Szechwan: Mohsimien (8,000 feet), Wa Shan (6,000-9,000 feet), Lianghowkow (12,000 feet), and Tachiao (12,000-13,000 feet), indicating, therefore, a considerable altitudinal range as well. The type series came from Omei Shan. North of these localities it does not seem to have been taken, so that, as in Europe, its distribution is slightly more austral than that of the striped-backed *A. agrarius*. The type specimen of *A. ilex* was one of a series from the Mekong-Salween divide, Yunnan, at between 13,000 and 14,000 feet, and Thomas in describing it mentions others from the Mekong-Yangtze divide (7,000-9,000 feet), the Kiukiang-Salween

divide (8,000-12,000 feet), and from the Mekong valley, 28° north, at about 7,000 feet. In the following year, he (Thomas, 1923, p. 661) also reported it from collections made at Likiang. Dr. R. C. Andrews, in his work in parts of this same area, found it abundant, and secured specimens from as low an altitude as 6,000 feet on the Salween divide at Mucheng, to 12,000 feet on the Likiang Range. He also traced it northward to within a few miles of Chung-tien in northwestern Yunnan. Farther west, Thomas (1921a) records it from Imaw Bum, Burma, and Hinton and Lindsay (1926) from the Mishmi Hills, India. Probably the intergradation with other races of *A. sylvaticus* is to be looked for across northern Burma and along the upper parts of the Himalayas, or even on their northern side, as well as in thinly wooded country to the north. They are found in western Yunnan in forest, in thickets, amongst rocks, and on alpine meadows.

Four small embryos were noted in a specimen taken at Omei Shan, August 16. No information as to the habits is at hand. Specimens taken at Wa Shan in late May seem to be undergoing moult of the winter pelage.

As an interesting variation, two out of the large series of skulls examined lack almost completely the antero-external small cusp on the second upper molar, thus approaching the condition normal in *A. agrarius*.

Specimens examined.—In all, two hundred and ninety-eight, from the following localities:

Hupei: Changyanghsien, 2 (M.C.Z.); Fanghsien (8,000 feet), 1 (M.C.Z.); Showlungtan, 1 (M.C.Z.).

Szechwan: Lianghokow, 1 (M.C.Z.); Mohsimien (8,000 feet), 2 (M.C.Z.); Tachiao, 5 (M.C.Z.); Wa Shan (7,000-9,000 feet), 12 (M.C.Z.); Omei Shan, 10, including the type (B.M.); Tatsienlu, 1 (B.M.); Weichow, 7 (B.M.), near *A. s. draco*.

Yunnan: Hapa, north of Taku (10,000 feet), 3; Homushu Pass (8,000 feet), 25; Hsiaokela (8,000 feet), 13; Hsiaotien, Mekong River (6,500 feet), 1; Lachumi, Mekong River (9,000 feet), 3; Likiang (10,000-12,000 feet), 56, 6 (B.M.); Mucheng, Salween drainage (7,000 feet), 70; Namting River, 1; Peitai (8,000-10,000 feet), 30; Peitaiping, 5; Songpa, 2; Taipingpu, Shweli River (8,000 feet), 3; Tomulang (10,000 feet), 7; Tugansha, 11; Yinpankai, Mekong River, 9; Mekong valley, 3 (B.M.); Kiukiang-Salween divide, 3 (B.M.); Mekong-Salween divide, 4, including type of *A. ilex* (B.M.); Chungtien, 1 (B.M.).

407. *Apodemus sylvaticus draco* (Barrett-Hamilton)

Mus sylvaticus draco Barrett-Hamilton, Proc. Zool. Soc. London, 1900, p. 418.

?*Mus badius* and *Mus argenteus* Swinhoe, Proc. Zool. Soc. London, 1870, p. 637.

Mus chevrieri Thomas, Proc. Zool. Soc. London, 1898, p. 773 (not of Milne-Edwards).

Type specimen.—An adult, skin and skull, No. 98.11.1.20, British Museum, from Kuatun, northwestern Fukien, China. Collected by J. D. La Touche.

Description.—This is a brighter-colored race than *A. s. orestes*, with a

slightly shorter tail, and with the ankles usually conspicuously dark all around instead of white as in that form. In general appearance it is not very different from typical *A. sylvaticus* of Europe, agreeing in its general ochraceous-buff coloring on the dorsal surface from near the base of the vibrissæ to the tail, but the back has a less-marked dark area, since the black hairs are more evenly distributed and scattered, and there is a conspicuous tuft of black hairs at the anterior base of each ear, while the ears themselves are dark, covered with extremely minute dark hairs. The dark ankle is a fairly constant mark distinguishing most specimens from the interior race, *A. s. orestes*, but occasional specimens of both are alike in this respect. Tail bicolor, nearly naked, blackish above, whitish below. Feet white. Lower surface of the body covered by hair having gray bases and white tips. A buffy chest spot is sometimes present.

The mammæ in most specimens are clearly: 1—2=6, but in two of the series examined the anterior pectoral pair is present though very small, and perhaps is not always functional.

Young or immature animals are nearly uniform gray, darker in the middle of the back.

The skull is not different from that of *A. s. orestes*.

Measurements.—In size this race is not very different from *A. s. orestes*, except for its distinctly shorter tail which is usually less than the combined length of head and body, or only slightly more. The following are from fresh specimens, as recorded by the collectors:

No.	Head and body	Tail	Hind foot	Ear	Locality
84759	87	91	20.0	15.0	Fukien
84773	93	92	20.0	15.0	Fukien
56434	106	97	25.0 (c.u.)	16.0	Hopei
56436	92	85	21.0	17.0	Hopei
56428	88	80	23.0	15.0	Hopei
84754	95	102	21.5	15.5	Fukien
85457	92	99	20.5	16.0	Fukien
84770	92	94	21.0	15.5	Fukien
84768	80	82	20.0	14.5	Fukien

For cranial measurements, see table under *A. s. orestes*.

Occurrence and Habits.—This little wood mouse occurs all over eastern China from Hopei southward to Fukien, and probably in northern Kwangtung, where, according to Mell (1922, p. 24), it is common in the mountain forests at elevations of from 550-900 meters, amongst rocks and undergrowth. The type and others from the wooded mountains of Fukien near Kuatun are not appreciably different in coloring and size from a series secured by the Central Asiatic Expeditions in the forested country near the Eastern Tombs of Hopei.

Their bright ochraceous backs, dark ankles, and slightly longer tails separate them from the race *A. s. orestes* of the western highlands, while from *A. peninsulae*, with which they are rather easily confused on account of the similar ochraceous tones, they may be at once distinguished externally by their blackish, not buffy, ears with black anterior tuft, and cranially by the fact that the postero-internal cusp of the first upper molar is well developed and as wide as the cusp in front of it, whereas in *A. peninsulae* it is reduced to a narrow ledge. The series from the Shangchow district and Lonanhsien, Shensi, recorded by Thomas as the latter animal, proves on more careful examination to be of this race. On laying out these skins, their conspicuously dark ears and black ear tufts distinguish them without recourse to the dental characters. Specimens in the British Museum from the Wenhsien district, Kansu, seem to be the same, but six from Weichow in the northwestern part of Szechwan are intermediate between *A. s. draco* and *A. s. orestes*, perhaps on the whole nearer the former. Probably as the wooded areas of eastern China are denuded, this species becomes scarcer, and as one approaches the more open country and the edge of the desert in Shansi and Shensi, it disappears, and its place is taken by *A. peninsulae* and races of *A. agrarius*. No attention has been paid to its habits in China.

Specimens examined:—The following fifty-four:

Hopei: Eastern Tombs, 4.

Fukien: Chunganhsien, 10; Kuatun, 26, including the type (B.M.).

Shensi: Shangchow district, 6 (B.M.); Lonanhsien, 1 (B.M.); Taipai Shan, 4 (B.M.).

Kansu: Wenhsien district, 3 (B.M.).

408. *Apodemus peninsulae* (Thomas)

Micromys speciosus peninsulae Thomas, Proc. Zool. Soc. London, 1906, p. 862.

Apodemus speciosus Thomas, *ibid.*, 1908, p. 641.

Apodemus speciosus peninsulae Thomas, *ibid.*, 1911, p. 172.

Apodemus speciosus peninsularis Thomas, *ibid.*, 1912, p. 136 (*lapsus calami*).

Type specimen:—An adult female, skin and skull, No. 6.12.6.45, British Museum, from Mingyong, one hundred and ten miles southeast of Seoul, Korea. Collected December 12, 1905.

Description:—It is characteristic of this mouse that the entire dorsal surface, including the exposed parts of the folded ear, is a uniform ochraceous buff, lined with black hairs which are more numerous over the lower part of the back but become few along the flanks, so that the extreme sides of the body are nearly clear ochraceous buff. There is no mid-dorsal narrow black streak. Tail bicolor, thinly haired, blackish brown above, white below. Backs of the hands and feet white. The lower surface of the body has the hairs gray at their bases, tipped with white.

Immature specimens are darker, since the ochraceous-tipped hairs have not fully developed. The mammae are eight in number, two pairs pectoral, two inguinal.

In its general features the skull of this mouse is not very different from that of *A. sylvaticus*. They agree in general size and in having three lobes on the internal side of the third upper molar. The tooth pattern, though similar, differs strikingly in the nature of the last inner cusp of the first upper molar. In *A. sylvaticus* and its races this is large, projecting inward practically as far as the middle one of the three inner cusps. Moreover, it is so high that with the two others it persists as a distinct lobe, even with considerable wear. In *A. peninsulæ*, on the other hand, this lobe is reduced to a narrow connecting ledge that is never so prominent as the lobe in advance of it, and with slight wear merges with the outline of the heel of the tooth.

Measurements.—In external measurements this species is very similar to *A. sylvaticus draco*, often found in the same regions. The following are from the labels of various specimens, as noted by the collectors:

No.	Head and body	Tail	Hind foot	Ear	Locality
15289 MCZ	118	97	25.0 (c.u.)	—	Korea
15288 MCZ	103	90	25.0 (c.u.)	—	Korea
8.8.7.38 BM	100	103	23.0 (s.u.)	15.0	Hopei
11.6.1.18 BM	80	75	21.0 (s.u.)	14.0	Shensi
11.2.1.136 BM	81	90	22.0	15.5	Kansu
11.2.1.137 BM	97	104	24.0 (?)	16.0	Kansu
11.2.1.138 BM	86	90	22.0 (s.u.)	15.0	Kansu
11.2.1.140 BM	91	97	22.5 (s.u.)	17.0	Kansu
11.2.1.142 BM	90	103	22.5 (s.u.)	16.5	Kansu
11.2.1.148 BM	94	96	24.0	16.0	Kansu

CRANIAL MEASUREMENTS OF *APODEMUS PENINSULÆ*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
11.2.1.138 BM	26.7	22.7	13.8	13.0	12.1	5.9	4.2	4.4	Kansu
11.2.1.134 BM	26.5	22.6	13.8	11.7	11.8	5.7	4.2	4.3	Kansu
11.2.1.142 BM	27.5	22.4	14.0	12.6	11.8	5.7	4.2	4.5	Kansu
11.2.1.143 BM	25.5	20.7	12.7	12.0	11.7	5.6	4.3	4.5	Kansu
8.8.7.38 BM	28.5	24.1	14.6	12.5	12.5	5.7	4.3	4.5	Hopei
8.8.7.41 BM	29.1	24.9	15.5	13.7	12.5	6.0	4.1	4.3	Shensi
8.8.7.43 BM	25.5	21.5	13.1	12.1	12.1	5.5	4.1	4.5	Shensi
6.12.6.45 BM (type)	28.1	24.7	15.3	13.7	11.9	5.8	3.9	4.5	Korea
56466	27.3	23.1	14.1	13.2	12.2	5.7	4.0	4.3	Hopei
56459	26.5	22.3	13.7	13.4	11.3	5.5	4.0	4.0	Hopei
56474	27.1	22.5	13.8	12.6	11.8	5.6	3.9	4.5	Shansi
45388	26.5	21.5	13.6	12.6	11.8	5.5	4.1	4.0	Shansi

Nomenclature.—In describing this mouse Thomas believed it to be the mainland representative of the Japanese *A. speciosus*, but after examining a series of specimens at the British Museum identified as the latter animal, it seems very doubtful to me if this is the case. The Japanese mouse is larger, with a longer hind foot (about 28 mm. with claws) and considerably larger skull. The coloration is darker, with a dark mid-dorsal area. Until a thorough revision of the group can be undertaken, therefore, it seems best to give the mainland animal specific standing. The possibility that true *A. speciosus* is a relative, instead, of one of the larger Asiatic species, such as Radde's *A. major*, should be considered.

Occurrence and Habits.—A common species "wherever scrub or woods are at all extensive" (Sowerby), this little mouse is found across northern China from the region of the Eastern Tombs in Hopei, southward to Taipai Shan, Shensi, and westward through most of the suitable country of Shansi and Shensi into Kansu. Dr. R. C. Andrews found it common in the region of the Eastern Tombs, northeast of Peiping, and collected it also at Kweihwacheng, Shansi, and near Fengsiangfu in Shensi. The specimens from Taipai Shan were from an altitude of 10,000 feet. A. B. Howell (1929) has also listed specimens in the U. S. National Museum from these same localities and from the vicinity of Yenanku and Sianfu, Shensi, as well as from south of Lanchow, Kansu. From the latter province, the Museum of Comparative Zoölogy has a series from Choni, and the American Museum a number from Archuen. Over this wide range there is remarkably little variation in appearance, so that Thomas (1911d), in recording specimens from southeast of Minchow, south and southeast of Taichow, and from the Wenhsien country, Kansu, writes that they are "similar in every respect to the Korean form, indicating the uniformity of the mammal fauna of North China north of 34°."

In contrast to the members of the *A. agrarius* group, with their striped backs, this species does not inhabit grassy fields, but prefers scrubby areas of bushy growth. Although, as in the Eastern Tombs area, it is often found in the same region with *A. sylvaticus draco*, it is not clear that it frequents the same type of cover. The two species are very easily told by their tooth and color characters: *A. peninsulae* with the reduced postero-internal lobe on the first upper molar, its uniformly buffy ears not different in color from the surrounding parts of the head and shoulders, and *A. sylvaticus draco* with the postero-internal lobe as well developed as the first and second, and with its dark blackish-brown ears in contrast to the ochraceous color of the adjacent parts.

The western limits of this species appear to be more extended than one would suppose. Thomas (1912e) has recorded a series from Weichow on the

Si Ho, western Szechwan, and from Hwayinsan, fifty miles northeast of Chungking, but on recently examining these, I find they are unquestionably *A. sylvaticus orestes*, which at that time Thomas had not described. Nevertheless, there is a specimen in the British Museum from the Chungtien plateau in extreme north-western Yunnan that is a perfectly typical *A. peninsulae*, notwithstanding that it is labeled "*orestes*," and Brooke Dolan, in 1934-36, secured specimens from Chinghai, and also from Dawo, Tunggnolo and Batang in extreme southwestern Szechwan, which must be at about the southwestern limit of its range. Probably, as with other North China species, the range extends southward along the eastern border of the Tibetan plateau. It remains to be established whether this mouse occurs in the wooded or scrubby country of northern Mongolia, along the northern edge of the Gobi, but this may well be the case, for there are two skins from forty-five miles north of Urga in the American Museum which are apparently this species. Their skulls, however, are missing.

Nothing distinctive as to the habits of this species has been published beyond the general fact of its habitat preference.

Specimens examined.—The following one hundred and twenty-four, in addition to the type:

Hopei: Eastern Tombs, 4, 1 (B.M.).

Shansi: Kweihwacheng, 7; Yirgo, 1 (M.C.Z.); twelve miles northwest of Kolanchow, 5 (B.M.).

Shensi: thirty miles south of Fengsiangfu, 2 (B.M.); forty-five miles south of Fengsiangfu, 2; Lonanhsien, 1 (B.M.); one hundred miles northwest of Taiyuanfu, 5 (B.M.); twenty miles east of Taiyuanfu, 2; Taipai Shan, 10,000 feet, 3.

Kansu: Archuen, 4; mountains south of Choni, 11, 42 (M.C.Z.); mountains southeast of Taochow, 13 (B.M.); ten miles south of Taochow, 3 (B.M.); sixty miles southeast of Minchow, 3 (B.M.).

Yunnan: Chungtien plateau, 11,000 feet, 1 (B.M.).

Szechwan: "Chinghai," 4 (A.N.S.P.); Dawo, 4 (A.N.S.P.); Tunggnolo, 5 (A.N.S.P.); Batang, 1 (A.N.S.P.).

409. *Apodemus latronum* Thomas

BIG-EARED WOOD MOUSE

Apodemus speciosus latronum Thomas, Abstract Proc. Zool. Soc. London, October 24, 1911, p. 49; Proc. Zool. Soc. London, 1912, p. 137.

Apodemus major G. M. Allen, Mem. Mus. Comp. Zool., vol. 40, p. 220, 1912 (not *Mus sylvaticus* var. *major* Radde).

Apodemus latronum Osgood, Publ. Field Mus. Nat. Hist., zool. ser., vol. 18, p. 318, 1932.

Type specimen.—An adult male, skin and skull, No. 11.2.1.156, British Museum, from Tatsienlu, Szechwan (now Hsikang), China, 9,000 feet altitude. Collected by Malcolm P. Anderson.

Description.—A large species, with large ears, long hind foot (25 mm. without claws), and without a definite black mid-dorsal line.

General coloring similar to that of *A. sylvaticus orestes* of the same regions, but usually rather more grayish. Dorsal coloring from muzzle to base of tail, mixed black and ochraceous or ochraceous buff, varying in individuals according to age and condition of pelage; the fore part of the muzzle slightly grayer than the forehead; the central area of the crown, nape and back darker than the cheeks, sides of neck and flanks; the lower back with a central area much darkened by black hairs. Ears larger than in other Chinese members of the genus, of a dark brownish color, thinly covered with minute blackish hairs, those at the anterior base abruptly longer and blackish brown, but not forming so conspicuous a tuft as in *A. s. orestes*. Tail not quite equaling head and body, its rings of scales showing through the sparse hairs, which are dark brown above and white below. Feet white, ankles dusky. Lower side of body with the hairs everywhere gray at base, tipped with dull white, the gray bases showing through.

The skull is large, with a long muzzle, and a strong line of beading over the eye, bending outward at the corner of the frontal, to traverse the outer border of the parietal as far as the outer lambdoid crest. The teeth recall those of *A. peninsulæ* in that the postero-internal lobe of the first upper molar does not project out so far as the two in front of it, yet is perhaps not quite so reduced as in that species. The second upper molar has three well-developed lobes on its inner border, and two on the outer, with a third very small cusplet on the antero-external corner. The last upper molar has three lobes on the inner border as in other members of the subgenus.

Measurements.—The striking features of size in comparison with other Chinese members of the genus are the long hind foot, of 25 to 26 mm. without the claws, the large ears of about 20 mm., and the tail of about the same length as head and body, though usually a trifle more. The following dimensions were taken by the collectors in the field:

No.	Head and body	Tail	Hind foot	Ear	Locality
II.2.I.150 BM	92	108	24.5 (s.u.)	18.0	Szechwan
II.2.I.153 BM	104	103	25.0	20.0	Szechwan
II.2.I.154 BM	104	110	26.0	19.5	Szechwan
II.2.I.155 BM	96	112	25.5	19.0	Szechwan
II.2.I.156 BM (type)	107	101	25.0	20.0	Szechwan
II.2.I.157 BM	95	100	25.0	19.0	Szechwan
II.2.I.159 BM	102	109	25.5	20.0	Szechwan
II.2.I.161 BM	99	103	24.0	20.0	Szechwan
43492	110	120	26.0	21.0	Yunnan
43493	107	109	24.0	21.0	Yunnan
43496	108	103	27.0	21.0	Yunnan

CRANIAL MEASUREMENTS OF *APODEMUS LATRONUM*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
11.2.1.153 BM	28.1	23.4	14.3	12.6	11.9	5.9	4.6	4.6	Szechwan
11.2.1.154 BM	29.1	24.6	15.0	12.8	12.5	5.8	4.6	4.5	Szechwan
11.2.1.158 BM	29.6	24.5	14.9	13.6	13.1	5.9	4.6	4.8	Szechwan
11.2.1.159 BM	28.0	23.9	14.4	13.1	12.3	6.0	4.6	4.5	Szechwan
11.2.1.156 BM (type)	29.0	24.5	15.2	13.2	12.7	6.0	4.7	4.4	Szechwan
12.3.18.10 BM	28.8	23.8	14.5	12.7	12.4	5.8	4.7	4.5	Yunnan
22.9.1.129 BM	29.0	—	15.2	12.9	13.2	5.9	4.7	4.7	Yunnan
12.3.18.5 BM	28.4	23.8	13.6	12.6	11.8	6.0	4.5	4.4	Yunnan
12.3.18.6 BM	28.8	24.6	14.5	13.0	12.1	6.1	5.0	4.7	Yunnan
12.3.18.9 BM	29.5	24.3	15.5	12.8	12.0	5.7	4.7	4.7	Yunnan

Nomenclature.—Although originally described as a race of *A. speciosus* by Thomas, there is no doubt that this represents a species quite distinct, and as Osgood (1932) has intimated, probably allied to "the large European species *epimelas* or *flavicollis*." Until a complete revision of the group can be made, however, it seems as well to use the binomial, awaiting a more accurate determination of its relationship. There is no doubt that it is closely allied to some of the larger forms of the subgenus *Sylvæmus*, as shown by the trilobate last upper molar. Its affinities to the large *A. major* (= *prætor*) will also have to be considered. A certain amount of variation in the number of mammæ is indicated by the specimens studied, for while the usual formula, 1—2=6, is shown by some specimens, others have the full eight present, making 2—2=8, as in No. 23.4.1.74, British Museum, from Likiang. In its general appearance it resembles *A. sylvaticus orestes*, but is larger with longer feet and ears.

Occurrence and Habits.—The Big-eared Wood Mouse is a common species in the forests of western Szechwan and the higher parts of Yunnan. The fine series in the British Museum that has been accumulated from 1912 to 1923 has at various times been mentioned by Thomas. This includes specimens from Tatsienlu, Szechwan, the type locality, at 9,000 feet, and others from Atuntze in northwestern Yunnan, 12,000 feet, and Likiang at altitudes from 10,000-12,000 feet. The American Museum Asiatic Expeditions have also secured a large number from the latter region at similar altitudes up to tree limit at 13,000 feet, as well as from localities in the Chungtien district, 10,000 feet; others were taken at Hapa, twenty miles north of Taku (9,000 feet), and Taku Hills, Yangtze River (9,000 feet), Yinpankai on the Mekong (9,000 feet), and Hsiaokela (8,000 feet). It is evidently a species of high altitudes in this part of China. A collector's note states that specimens were trapped "under the roots of big trees in damp alpine forests," or on dry hillsides and in alpine meadows. Nothing of special significance is known as to the habits otherwise.

A series in the British Museum, from Atuntze, Yunnan, taken in late May, is still in winter pelage—ears blackish, thinly haired, the fur on the body long and silky, broadly tipped with ochraceous, looking much buffier than in the summer pelage, in which the greater admixture of black gives a more olive appearance. Two taken on May 31 are beginning to change, and show the dull olive-ochraceous summer fur on the muzzle and fore part of the head, with ragged shoulders.

Osgood (1932) has recorded a series of specimens secured by the Field Museum expeditions from localities in western Szechwan and Yunnan, not distant from those mentioned above. A series of ten specimens collected by Brooke Dolan at Batang, Szechwan, may mark nearly the western limit of the range.

Specimens examined:—The following one hundred and seventy-eight:

Szechwan: Tatsienlu, 10, including the type (B.M.); Tachiao, 4 (M.C.Z.); Lianghokow, 2 (M.C.Z.); Shuowlow, 7 (M.C.Z.); Ramala Pass, 2 (M.C.Z.); Batang, 10 (A.N.S.P.).
Yunnan: Atuntze, 9 (B.M.); Chaotungfu, 2 (B.M.); Hapa, twenty miles north of Taku, 2; Hsiaokela, 1; Kiukiang-Salween divide, 1 (B.M.); Likiang, 103 (A.M.N.H.), 4 (B.M.); Mekong-Salween, 5 (B.M.); Taku Hills, 3; Tomulang, 4; Tugansha, 7; Yinpankai, 1; Yangtze-Mekong drainage, 1.

Subgenus *Apodemus* Kaup

Apodemus Kaup, Entwickl.-Gesch. u. Natürl. Syst. Europ. Thierwelt, vol. 1, p. 150, 1829.

As first pointed out by Thomas, the members of the typical subgenus *Apodemus* are distinguished by having the skull slightly convex on its upper profile, a prominent line of beading above the orbit and by having but two lobes of enamel on the inner side of the last upper molar. In the more northern members of this group, of which the type species is the European *A. agrarius*, there is a sharply defined black mid-dorsal stripe, but in the more southern Chinese members, this becomes a diffuse and slightly darker area, or may be altogether obsolete, and the back evenly colored, a condition which, as exemplified by the race *A. a. chevrieri* of Szechwan and Yunnan, is perhaps the primitive one, and is further evidence of the preservation in the Chinese highlands of the more ancient types of small rodents that elsewhere have become more differentiated. The number of mammæ is eight, two pairs pectoral and two abdominal. Four races of this group, all regarded as forms of a single species, are known from China. They are to some extent, as their Latin name implies, more agrarian than sylvan in habitat, in contrast to the members of the *A. sylvaticus* group.

410. *Apodemus agrarius chevrieri* (Milne-Edwards)

Mus chevrieri Milne-Edwards, Recherches pour servir à l'Hist. Nat. des Mammifères, p. 288, pl. 40, fig. 2, 1868-74.

Apodemus fergussoni Thomas, Abstract Proc. Zool. Soc. London, February 14, 1911, p. 4; Proc. Zool. Soc. London, 1911, p. 172. Wenhsien district, Kansu.

Apodemus speciosus chevrieri Thomas, Proc. Zool. Soc. London, 1911, p. 172.

Apodemus chevrieri Thomas, Proc. Zool. Soc. London, 1912, p. 135; Ann. Mag. Nat. Hist., ser. 8, vol. 9, p. 516, 1912. G. M. Allen, Mem. Mus. Comp. Zool., vol. 40, p. 222, 1912.

Apodemus chevrieri fergussoni Thomas, Proc. Zool. Soc. London, 1912, p. 135.

Apodemus agrarius chevrieri G. M. Allen, Amer. Mus. Novitates, no. 270, p. 5, 1927.

Type specimen.—This mouse was described from specimens obtained in the principality of Muping, central Szechwan, by Père David, by whom they were sent to the Paris Museum. Although no specimen is designated as the type, Milne-Edwards specially mentions an adult female, the dimensions of which he gives. If this is still in existence, it should be considered as a lectotype.

Description.—Externally this wood mouse recalls *A. peninsulae* but is darker, the entire dorsal surface a rich ochraceous, heavily lined with black, particularly in the central area of the back, producing a rather characteristic tone of dull, deep ochraceous. The ears are small and colored nearly like the adjacent parts on their exposed surfaces. Backs of the feet gray. Tail bi-color, but lacking a sharp transition from the blackish-brown upper surface to the whitish under side, the hairs minute, not obscuring the scales. Belly and throat whitish with the gray bases of the hairs showing through.

The skull with its teeth is distinctive. The last upper molar has two instead of three lobes on its inner border, and the second upper molar has the antero-external cusp lacking, giving this corner of the tooth an abruptly reduced appearance. The postero-external corner of the same tooth is similarly reduced, though showing a small cusp, while on the inner side of the tooth there are three well-defined cusps, one for each of the original transverse rows. The anteriormost upper molar is the largest, as usual, with its tubercles in three clearly marked transverse rows of three. In each row the median tubercle is the largest. In the first transverse row the inner tubercle is slightly displaced backward, while at the postero-external corner there is a minute fourth tubercle, varying in size in different individuals. The skull is not specially characteristic in appearance, but has a well-marked raised line of beading beginning at the front of the orbit, and overhanging it slightly, but ending abruptly about half-way along the outer border of the parietal.

Measurements.—This species differs from the Chinese members of the *A. sylvaticus* group and its allies in the small size of the ears, and in having the tail considerably shorter than head and body. The following are collectors' measurements from fresh specimens:

No.	Head and body	Tail	Hind foot	Ear	Locality
43659	88	83	22.5	14	Yunnan
43693	120	105	23.0	16	Yunnan
43856	103	93	23.0	15	Yunnan
43869	88	73	22.0	14	Yunnan
43875	99	84	22.0	15	Yunnan
43977	110	96	21.5	15	Yunnan
7621 MCZ	107	78	25.0	—	Szechwan
7625 MCZ	98	85	24.0	—	Szechwan
7657 MCZ	99	99	22.0	—	Szechwan
7623 MCZ	97	84	23.0	—	Szechwan

CRANIAL MEASUREMENTS OF *APODEMUS AGRARIUS* RACES

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
<i>A. agrarius chevrieri</i>									
43659	26.3	21.7	13.1	11.7	12.0	5.5	4.3	4.4	Yunnan
43693	29.5	25.8	15.0	—	12.1	5.9	4.3	4.5	Yunnan
43856	27.5	23.2	13.7	13.2	11.6	5.8	4.3	4.3	Yunnan
43875	27.5	23.2	14.1	12.9	12.4	5.7	4.2	4.3	Yunnan
43977	27.7	24.0	14.2	13.9	11.5	5.7	4.2	4.4	Yunnan
7625 MCZ	26.3	22.4	13.8	12.5	12.1	5.5	4.4	4.5	Szechwan
7631 MCZ	26.5	21.8	13.2	13.4	11.7	5.7	4.0	4.4	Szechwan
7657 MCZ	28.1	24.5	14.7	13.0	11.7	5.7	4.3	4.4	Szechwan
7136 MCZ	29.0	24.7	14.7	—	12.5	6.1	4.5	4.6	Hupei
7621 MCZ	27.0	23.3	14.2	12.5	11.7	5.7	4.6	4.8	Szechwan
<i>A. agrarius mantchuricus</i>									
56216	26.1	21.3	12.9	11.4	11.0	5.1	3.9	4.2	Hopei
<i>A. agrarius pallidior</i>									
23491 MCZ	24.1	19.9	12.2	11.6	11.1	4.9	4.2	4.2	Szechwan
23492 MCZ	25.1	21.2	12.3	12.4	11.3	5.4	4.0	3.9	Szechwan
23493 MCZ	24.7	19.7	12.5	10.5	10.7	5.1	3.9	3.8	Szechwan
23494 MCZ	27.0	23.4	13.7	12.7	10.9	5.8	4.0	4.2	Shensi
23495 MCZ	26.8	22.5	13.9	12.2	11.6	5.6	4.1	4.0	Shensi
23496 MCZ	27.6	22.6	13.7	12.7	11.6	5.4	4.0	3.9	Shensi
<i>A. agrarius ningpoensis</i>									
56475	25.5	21.3	12.6	11.5	10.5	5.2	4.0	4.4	Hunan
56480	26.5	23.2	13.6	—	11.5	5.4	4.1	3.8	Hunan
56767	28.5	24.2	14.5	13.1	11.7	6.0	4.1	4.1	Hunan
23490 MCZ	26.5	22.4	13.4	12.7	11.3	5.7	4.3	4.3	Hunan
24279 MCZ	25.7	22.0	12.8	—	11.0	5.4	3.9	3.9	Chekiang
24290 MCZ	24.8	20.7	12.3	—	11.2	5.4	3.8	3.8	Chekiang
24293 MCZ	25.3	21.5	12.6	12.3	11.5	5.2	4.0	4.4	Chekiang

As often among rodents, occasional individuals attain a size above the average, reaching the proportions of a small rat.

Nomenclature.—There is no doubt that this mouse, originally described as a distinct species, is, after all, but a subspecies of the animal first made known from European specimens of the striped-backed field mouse, *Apodemus agrarius*. In its lack of a distinct narrow spinal stripe of black, however, it perhaps represents the most primitive race of the group, with the uniformly scattered black hairs of the dorsal pelage forming only a slightly darker area over the lower back. Thomas in 1911 regarded it as a race of the more eastern *A. speciosus*, but later gave it the standing of a full species. He also described in 1911 *A. fergussoni* from the Wenhsien district of southern Kansu, but later recognized its affinity to *A. chevrieri*, of which he suggested it might be a subspecies. The interesting point is that on the borders of its range where it

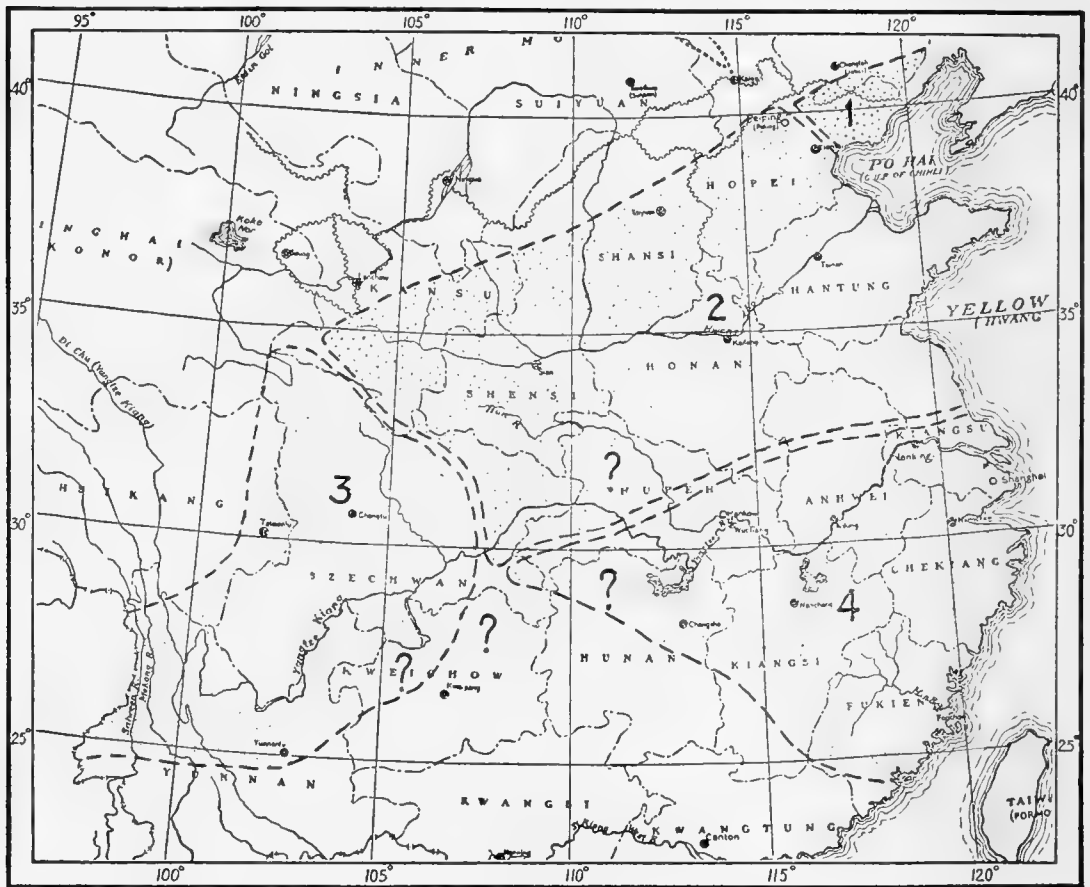


FIG. 47. Distribution Map.
Apodemus

1. *A. agrarius mantchuricus*
2. *A. agrarius pallidior*

3. *A. agrarius chevrieri*
4. *A. agrarius ningpoensis*

merges into *A. agrarius pallidior*, some specimens develop the spinal stripe characteristic of the lowland forms, while others do not, even in the same locality. It is therefore regarded now as a synonym of *A. agrarius chevrieri*. Intergradation of a similar sort takes place in western Hupeh.

Occurrence and Habits.—This brightly colored wood mouse is common in the highlands of western China from western Hupeh and southern Kansu southwestward across Szechwan and Yunnan, from middle altitudes to the high alpine meadows from 6,000-10,000 feet. The American Museum Asiatic Expeditions found it abundant and a characteristic species in the Chungtien district of northwestern Yunnan, over the intermediate country to the Likiang Range and southeastward to Tali Lake. It has been taken at various localities across Szechwan and as far south as the mountainous regions of Wa Shan and Omei Shan. Thomas (1898) earlier recorded it from Kuatun in the uplands of Fukien, but the specimens proved later to be *A. sylvaticus draco*. Common as it appears to be, nothing is recorded of its habits or life history. The following records of mature embryos in specimens taken by the American Museum Asiatic Expeditions on the Likiang Range are therefore interesting. Of six pregnant females taken October 5, 1916, two contained four embryos each, one had five, one six, and two seven each.

Specimens examined.—The following two hundred and twenty-eight:

Szechwan: Yinchinwan, 2 (B.M.); southwest of Ningyuan, 7 (B.M.); Weichow, 1 (B.M.);

Omei Shan, 1 (B.M.); Wa Shan, 13 (M.C.Z.).

Hupeh: Hsingshanhsien, 1 (M.C.Z.).

Yunnan: Chaotungfu, 1 (B.M.); Kiukiang-Salween divide, 1 (B.M.); Likiang, 19 (B.M.), 89 (A.M.N.H.); Chungpa, 2; Chungtien, 2; Hapa, 3; Hsiaokela, 3; Hsiaotien, 3; Chiangwei, 11; Lachumi, 1; Mucheng, Salween divide, 2; Peitai, thirty to forty miles south of Chungtien, 10,000 feet, 9; Shasungshoo (Mekong), 3; Songpa, 2; Taku Ferry, 7; Tali Lake and vicinity, 11; Tomulang, 8; Wutinghsien, 6; Yangtze-Mekong divide, 2; Yangtze River, Chitien, 2; Lasaku, 3; Shihku, 3; Yinpankai, 4; Yunnanfu, 4.

411. *Apodemus agrarius mantchuricus* (Thomas)

Mus agrarius mantchuricus Thomas, Proc. Zool. Soc. London, 1898, p. 774, footnote.

Apodemus agrarius coreæ Thomas, Proc. Zool. Soc. London, 1908, p. 642. A. B. Howell, Proc. U. S. Nat. Mus., vol. 75, art. 1, p. 57, 1929.

Apodemus agrarius mantchuricus G. M. Allen, Amer. Mus. Novitates, no. 270, p. 4, 1927.

?*Apodemus agrarius gloveri* Kuroda, Bull. Biogeogr. Soc. Japan, Tokyo, vol. 9, p. 28, January 31, 1939. Altorian, Nekka province (Jehol).

Type specimen.—A skin and skull in the British Museum, No. 83.2.24.1, from "Manchuria"; according to Bonhote (1906), from near the Korean border. Collected by Dr. Janskowski.

Description.—General color slightly grayer and buffier than *A. a. chevrieri*, with a sharply defined narrow black stripe from the occiput to base of tail.

Face and muzzle grayish passing into buff, with an ochraceous-buff narrow eye-ring. Forehead and the upper parts of the back just lateral to the dorsal stripe with an even mixture of black among ochraceous hairs, passing into buffy on the sides. The even distribution of the black hairs does not cause a darker clouding over the dorsum. Tail blackish brown above, thinly haired; below, white. Backs of the feet grayish white. Ventral surface of the body with the hairs gray at their bases, tipped with white, but the gray showing through. Ears nearly naked, but thinly clothed with minute black and buffy hairs.

The skull is essentially similar to that of *A. a. chevrieri*, with the same prominent line of beading overhanging the orbit, two inner lobes to the third upper molar, and the lack of an antero-external tubercle on the second upper molar.

Measurements:—The external measurements of four specimens referred to this race are recorded by the collector as follows:

No.	Head and body	Tail	Hind foot	Ear	Locality
56214	110	—	22	13	Hopei
56215	100	80	22	13	Hopei
56216	103	75	20	13	Hopei
56217	105	80	22	14	Hopei

From these measurements, it appears that the tail length bears an even smaller proportion to that of head and body than in *A. a. chevrieri*, averaging between 75 and 80 per cent.

For cranial measurements of *A. agrarius mantchuricus*, see table under *A. a. chevrieri*.

Occurrence and Habits:—The striped-backed field mice of northern Hopei are obviously brighter in color than those of the more arid regions to the south and west representing the race *A. a. pallidior*. Thomas (1908f, p. 642) recorded specimens from the Eastern Tombs region, sixty-five miles northeast of Peiping as *A. agrarius coreæ*, and A. B. Howell (1929, p. 57) follows him in so referring other specimens from that vicinity in the U. S. National Museum. A comparison of specimens from that locality with others from Hozando, Korea, indicates, however, that the latter represent a more brightly colored animal. Moreover, the type locality, some hundred miles southeast of Seoul, seems to be in a region of moister climate, with the race *A. a. mantchuricus* described from the area between. I would agree with Bonhote (1906) in regarding these northern Hopei specimens as representing the latter race. Thomas (1908f) contrasts its habitat with that of *A. peninsulae*, a scrub dweller, for this striped-backed animal lives "in the tall grass, which grows in certain open valleys."

Kuroda has lately described as *Apodemus agrarius gloveri* a field mouse from Altorian, Jehol, giving as diagnostic characters the narrower dorsal stripe

as compared with the European typical race, and the duller color of the back as compared with *A. a. mantchuricus*. In view of the great variation in these respects, however, I have provisionally regarded this as a synonym of *A. a. mantchuricus*.

Specimens examined:—Four from the Eastern Tombs, Hopei.

412. *Apodemus agrarius pallidior* Thomas

Apodemus agrarius pallidior Thomas, Proc. Zool. Soc. London, 1908, p. 7.

Type specimen:—An adult male, skin and skull, No. 8.2.8.29, British Museum, from near Chefoo, Shantung, China. Collected April 5, 1907, by Malcolm P. Anderson.

Description:—A field mouse with a distinct and fairly sharp spinal stripe of black, the shoulders pale grayish ochraceous. The general color above is much paler than in *A. a. mantchuricus*, lacking the warm almost ruddy tone of ochraceous, and being instead more grayish across the shoulders and on the head. The dorsal streak is also less sharp in some specimens, but not so nearly obsolete as in the more southern race, *A. a. ningpoensis*. In other respects it agrees with adjacent races, as in the whitish hands and feet, the bicolor tail, and the whitish tips to the hair of the lower surface.

Measurements:—Although in his original description Thomas says that in size it perhaps averages "rather less than in the more northern races," the differences are very small indeed. The following are from fresh specimens as taken in the field by the collectors:

No.	Head and body	Tail	Hind foot	Ear	Locality
8.2.8.29 BM (type)	93	100	19 (s.u.)	13	Shantung
32288	106	104	22	14	Shensi
32290	80	72	19	13	Shensi
56272	113	86	21	14	Shensi
56297	95	77	22	13	Shensi
56298	110	89	22	15	Shensi
59873	100	84	21	15	Szechwan
59875	90	75	20	14	Szechwan
59882	95	75	21	13	Szechwan
59886	96	85	21	14	Szechwan

The field measurements of the type, as quoted above from Thomas, are probably too large for tail, since this in a large series usually measures considerably less (about 20 per cent less) than the head and body.

For cranial measurements, see table under *A. agrarius chevrieri*.

Occurrence and Habits:—This is a common race in some parts of northern China, distinguished by the sharply marked dorsal stripe and the generally pale ground color of the upper parts. On the northeast it intergrades with the race

A. a. mantchuricus from the Peiping area eastward; to the south it merges into the race *A. a. ningpoensis* in the Yangtze valley; while to the westward it extends across the drier areas of Shansi and Shensi, passing into the race *A. a. chevrieri* in southern Kansu. The type and other specimens serving for the original description were from Shantung—Chefoo and the immediately surrounding country. Thomas (1909, p. 973) records it from twelve miles northwest of Kolanchow, Shansi, and from thirty miles west of Fenchowfu, Shansi; while later (1911d) he mentioned specimens in the British Museum from Sihhsien and Wenhsien in southern Kansu. Here it was taken in "cultivated fields," but seemed rare. Others he (1911) records from the Shangchow district of Shensi (Shannanhsien, Lonanhsien, and thirty miles south of Fengsiangfu), while Clark and Sowerby (1912) secured specimens at Yenanku, and Liutsun (fifteen miles south of Sianfu in the same province) and add that it was captured usually in low bushy country, hilltops or valleys, amongst loose stones, in small cypress wood, or along the bottoms of deep ravines. Evidently it occurs wherever sufficient shelter and vegetation are found in this arid area. The Central Asiatic Expeditions brought back a fine series, which seem best referred to this race, from the base of Taipai Shan in southern Shensi, as well as from Fengsiangfu. The limit of its range to the southwest is doubtless in the extreme eastern part of Szechwan, whence they secured a series at Wanhsien on the Yangtze.

Specimens examined:—The following two hundred and twenty-six:

Shensi: Fengsiangfu, 8; base of Taipai Shan, 83.

Szechwan: Wanhsien, 121.

Kansu: Archuen, 9; Machu, 3; Tsuchow, 2.

413. *Apodemus agrarius ningpoensis* (Swinhoe)

Mus ningpoensis Swinhoe, Proc. Zool. Soc. London, 1870, p. 637.

Mus harti Thomas, Proc. Zool. Soc. London, 1898, p. 774. Kuatun, Fukien.

Apodemus agrarius ningpoensis Thomas, *ibid.*, 1908, p. 8. G. M. Allen, Mem. Mus. Comp. Zool., vol. 40, p. 219, 1912.

Apodemys agrarius Shih, Bull. Dept. Biol., Sun Yatsen Univ., Canton, no. 4, p. 8, 1930.

Type specimen:—The type is said to be in the Berlin Museum, having been sent to W. Peters by Robert Swinhoe who obtained it at Ningpo, Chekiang, China, about 1869.

The type of Thomas's *Mus harti*, a synonym, was from Kuatun, Fukien, No. 98.11.1.18, British Museum.

Description:—In general this race resembles *A. a. pallidior*, but averages more uniform in the mixed ochraceous and black of the dorsal coloring, instead of having paler shoulders, while the chief other distinction lies in the fact that the dark dorsal stripe is obsolete and instead of being a sharply defined spinal streak is represented by a narrow darker area mid-dorsally, with indistinct

boundaries. There is, however, much variation in this character, some specimens in the intergrading areas having almost no trace of a distinct stripe, while in others it may be almost as sharp as in *A. a. pallidior*.

Measurements:—While of about the same general size as the more northern race, this southern subspecies seems to have a tail more nearly equaling the length of head and body, as the following measurements selected from a considerable series taken in the field, seem to show.

No.	Head and body	Tail	Hind foot	Ear	Locality
56193	98	115	20	13	Hunan
56195	87	90	21	12	Hunan
56197	88	89	22	14	Hunan
56479	90	90	20	14	Hunan
84774	95	84	20	15	Fukien
7157 MCZ	95	81	22	—	Hupeh
7172 MCZ	94	90	22	—	Hupeh

For cranial measurements, see table under *A. a. chevrieri*.

Occurrence and Habits:—The slightly warmer color above, the lack of definition to the outlines of the dorsal stripe, and the tendency to its obliteration are the distinguishing features of this race, which is in general the form of South China from the northern border of the Yangtze basin, Anhwei and Kiangsu, southwest into western Hupeh (Ichang), and south to parts of northern Fukien and Hunan. How far into southeastern China it extends is still uncertain, but Shih (1930) has recorded as *Apodemys agrarius* what is probably this animal from Yao Shan, Kwangtung. Probably here it is near its southern limits, and is perhaps confined to higher levels. Intergradation takes place with neighboring races, so that it is difficult to refer all specimens from western Hupeh to one or the other, for, although most of them have the diffuse dorsal blackish area, others have a fairly well-defined stripe. A series from Ichang in the Museum of Comparative Zoölogy I have on the whole considered as nearer to this race than to *A. a. pallidior*, while referring to the latter a series from Wanh sien in eastern Szechwan. A. B. Howell (1929) lists a series in the U. S. National Museum from Taiping in Anhwei, and from Nanking, Chinkiang, and Shanghai in Kiangsu. In its habits it does not seem to show anything characteristic. Thomas (1908), however, mentions that those secured in northwestern Fukien were taken "in traps under rocks near water courses." It was from this area that he described "*Mus harti*," but later recognized that it is the same as *A. a. ningpoensis*.

Specimens examined:—The following sixty-one:

Hunan: Yochow, 30.

Hupei: Ichang and vicinity, 30 (M.C.Z.).

Fukien: Chunganhsien, 1.

Genus *Micromys* Dehne

HARVEST MICE

Micromys Dehne, Ein neues Säugthier der Fauna von Dresden, 1841, p. 1.

Mus in part, Blasius, Säugethiere Deutschlands, 1857, p. 309; and other earlier authors.

The harvest mice are among the smallest of rodents, and were by the older authors included in the genus *Mus*, but are now regarded as a distinct genus, the characters of which were first clearly set forth by Miller (1912, p. 840). He points out among the distinctive external features the small size (head and body 75 mm. or less), the short rounded head due to the shortened rostrum, the short rounded ear reaching barely half-way to the eye when laid forward, the relatively broad feet for climbing, with the posterior tubercles of the fore feet confluent, forming with the thumb a single tubercular mass, and finally the naked condition of the terminal fifth or sixth of the upper side of the tail, a specialization correlated with the prehensile use of this organ. The skull is essentially like that of a small *Apodemus*, with smooth brain case, but the rostrum is much shortened. The interparietal bone is wide and strap-shaped, slightly produced in the median line at the front and back. The tooth pattern resembles that of *Apodemus sylvaticus*, with the tubercles of the two upper anterior molars arranged in three transverse rows of three each; the innermost one of the first row in m^1 is slightly displaced backward, and the inner- and the outermost ones of the third row on the same tooth are much smaller than those anterior to them. In the second upper molar the inner and outer tubercles of the first transverse row are much smaller than those of the second row, while those of the third row are so reduced as to be scarcely evident. The last upper molar has the tubercles much reduced, with but two reaching the inner side of the tooth. In the lower teeth the outer ledges of the two anterior teeth are more reduced than in *Apodemus*, and show no cusp development. The mammae are eight in number, two pairs pectoral and two pairs inguinal.

The type species of the genus is *Micromys agilis*, which in turn is a synonym of *Mus soricinus* Hermann, a name now used in a subspecific sense for the harvest mouse of central Europe. The first-described form is the *Mus minutus* of Pallas from the banks of the Volga, Russia.

The species *Micromys minutus* is of widespread occurrence, quite across the temperate parts of Europe and Asia where suitable conditions are found. Over this wide area it varies relatively little, so that distinctions into local races are made with difficulty. So far as the specimens hitherto compared go, but a single race seems to inhabit central China.

414. *Micromys minutus pygmæus* (Milne-Edwards)

Mus pygmæus Milne-Edwards, Recherches pour servir à l'Hist. Nat. des Mammifères, p. 291, pl. 43, fig. 1. 1868-74.

Mus minutus pygmæus Barrett-Hamilton, Ann. Mag. Nat. Hist., ser. 7, vol. 3, p. 343, 1899.

Micromys pygmaeus J. A. Allen, Bull. Amer. Mus. Nat. Hist., vol. 26, p. 428, 1909. Thomas, Proc. Zool. Soc. London, 1912, p. 137.

Micromys minutus Thomas, Proc. Zool. Soc. London, 1911, p. 690.

Apodemus minutus pygmaeus G. M. Allen, Mem. Mus. Comp. Zool., vol. 40, p. 220, 1912.

Micromys minutus pygmaeus G. M. Allen, Amer. Mus. Novitates, no. 270, p. 7, 1927.

Micromys minutus berezowskii Argyropulo, Compt. Rend. Acad. Sci. URSS., 1929A, p. 253. Lunganfu, Szechwan.

Type specimen.—The original specimen was sent by Père Armand David from Muping, central Szechwan, China, to the Paris Museum, in which it presumably still is, for Thomas (1898) mentions examining it. No single specimen was designated as type, however, but there was evidently more than one, for the British Museum has a specimen received from the Paris Museum, collected by David in "eastern Tibet," as Szechwan was in 1870 considered.

Description.—Entire dorsal surface of the body, including the exposed parts of the ears, a dull russet, evenly and minutely lined with black hairs, which are most abundant on the posterior part of the mid-dorsal region and fewest on the flanks, so that the tint is darker on the former and slightly clearer on the latter. The rump in some specimens becomes distinctly ruddy, nearly dull ferruginous, contrasting with the more gray anterior portion of the body. The color of the sides shades gradually into that of the ventral surface, which is everywhere gray-based, with the tips of the hairs dull white, or in some specimens washed throughout with ochraceous. The tail is bicolor, very thinly haired, blackish above and slightly paler beneath. The backs of the feet are buffy.

Immature specimens lack the russet tints on the dorsal surface and are instead much duller, with darker backs and less of the ochraceous-tipped hairs.

The characters of the skull and teeth are noted in the account of generic distinctions.

Measurements.—The small size of this little mouse is obvious from the following measurements of fresh specimens:

No.	Head and body	Tail	Hind foot	Ear	Locality
43627	65	74	16.5	10.0	Yunnan
43629	60	61	15.0	9.5	Yunnan
43631	60	60	14.0	10.0	Yunnan
43633	68	64	15.0	10.0	Yunnan
43635	60	66	16.0	10.0	Yunnan
43640	63	64	15.0	11.0	Yunnan
43641	63	72	16.0	11.0	Yunnan
43643	67	70	15.0	10.0	Yunnan
56418	62	73	16.0	10.5	Szechwan
84775	62	75	15.0	10.5	Fukien
11.9.8.102 BM	65	72	15.5	11.0	Szechwan

Thomas has shown (1898, p. 775) that Milne-Edwards's measurement of

the hind foot of the type, given in the original description as 18 mm., is evidently a misprint, for he found it to be (without claws) 13.9 mm.

CRANIAL MEASUREMENTS OF *MICROMYS M. PYGMÆUS*

No.	Greatest length	Basal length	Palatal length	Zygomastic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
43629	18.5	14.8	9.5	9.0	9.0	—	3.2	3.0	Yunnan
43634	18.0	15.0	9.4	9.5	8.7	—	3.1	3.1	Yunnan
43642	18.3	15.0	9.2	—	8.0	—	3.0	3.0	Yunnan
43643	18.5	16.0	9.4	—	8.3	—	3.0	3.0	Yunnan
56415	19.3	16.0	9.5	8.6	8.3	—	3.0	3.0	Szechwan
0.5.8.33 BM	18.9	16.0	9.6	—	9.4	3.6	2.9	2.8	Fukien
98.II.I.13 BM	17.8	14.6	8.6	9.2	9.1	3.7	2.7	2.6	Fukien
98.II.I.14 BM	18.9	15.8	9.6	9.7	9.4	3.9	3.0	2.8	Fukien
II.9.8.101 BM	18.4	15.2	9.3	9.7	9.2	3.8	3.1	2.8	Szechwan
II.9.8.102 BM	19.5	15.9	9.3	9.5	9.2	3.8	3.1	2.9	Szechwan

Nomenclature.—These small mice vary surprisingly little in the wide range from western Europe to central and eastern Asia. The differences are in slight shades of color, and there is more or less individual variation according to age, the adults becoming slightly more rusty on the rump. The belly varies in series from the same region, from whitish tipping of gray-based hairs to those with the entire under parts suffused with buff. A specimen from Shangchow, southeastern Shensi, has the hair of the throat, chest, and inguinal region pure white to the roots, the middle part of the abdomen gray-based. It is still to be shown that the Chinese specimens are really different from *M. minutus erythrotis* Blyth, type locality Khasi Hills, Assam, which, according to Osgood (1932, p. 318), is "the oldest name for any Asiatic *Micromys*." Nevertheless, the Chinese animal is considerably darker and less brightly colored than that of central Europe. It can scarcely be doubted that Argyropulo's *M. m. berezowskii* described in 1929 from near Lunganfu, Szechwan, is a synonym, coming as it does from the northeastern part of Szechwan where the fauna is hardly different from that of the type locality of *M. m. pygmæus*.

Occurrence and Habits.—Although apparently nowhere abundant, this little mouse seems generally distributed over the central and southern parts of China, especially where some remnant of the original cover remains. There are no records of it for the northeastern provinces of Hopei, Shantung or Anhwei, but it has been taken in southeastern Shensi in the Shangchow district and at the base of Taipai Shan. Thomas (1898) records specimens from Shanghai collected by Swinhoe, as well as others from Kuatun, Fukien. W. R. Zappey collected it in western Hupeh at Changyanghsien, and the American Museum Asiatic Expeditions have secured a series at various points in Szechwan and Yunnan, from Wanhsien in the eastern part of the former province to

points on the Yangtze-Mekong drainage and Mucheng, on the Salween drainage in the latter province, including localities of between 4,000 and 8,000 feet altitude, as Hsiaokela, Hsiaotien, Waita, and Chunglu on the Mekong and Salween Rivers. How far south it may be found in China is still to be determined, but Mell (1922) has reported it from northeastern Kwangtung, and Osgood (1932) from Indo-China.

Sowerby (1923) reports securing a specimen at Nanking on the Yangtze, and A. B. Howell (1929) mentions what may be the same specimen, now in the collection of the U. S. National Museum. Since the species is represented by a large dark race in the Ussuri region, it is quite likely that specimens will eventually be taken in the intermediate country of northeastern China.

Little is recorded of its habits in China. The British Museum has a specimen, accompanied by two very small young, from Kuatun, Fukien, and Mell records a nest found at about a foot from the ground in dwarf bamboos about a meter high, on the border of a wood, and a second nest farther in the forest.

Specimens examined:—The following thirty-eight:

Fukien: Chunganhsien, 2; Kuatun, 9 (B.M.).

Hupeh: Changyanghsien, 1 (M.C.Z.).

Shensi: Shangchow, 1 (B.M.).

Szechwan: Mingyuan, 2 (B.M.); Wanhhsien, 4; "E. Tibet" = Muping, 1 (B.M.).

Yunnan: Chunglu, 3; Hsiaokela, 4; Hsiaotien, 1; Mucheng, Salween drainage, 6; Salween drainage, 1; Waita, 1; Yangtze-Mekong drainage, 2.

Genus *Leggada* Gray

JUNGLE MICE

Leggada Gray, Mag. Nat. Hist., ser. 2, vol. 1, p. 586, 1837. Thomas, Journ. Bombay Nat. Hist. Soc., vol. 26, p. 417, 1919.

Mus in part, of older authors.

The genus *Leggada* was established by J. E. Gray for the two Indian species, *L. booduga* and *L. platythrix*, the Indian spiny mouse, but its members so closely resemble typical *Mus* in tooth pattern that they have been, until recent years, either placed in that genus or regarded as at most a subgeneric group of it. Thomas in 1919 more carefully defined the characters distinguishing the two, and regarded *Leggada* as an independent genus having a tropical distribution in the oriental and Ethiopian regions, while *Mus* is naturally a genus chiefly of the north temperate zone. *Leggada* is less specialized than *Mus* in having the rostrum of the skull longer in proportion instead of much shortened as in the latter, so that the distance from the gnathion or bony edge in front of the upper incisors to the front bottom corner of the zygomatic plate exceeds the breadth across the molars instead of being equal to that distance or slightly less. The nasals are consequently longer and narrower, tapering

backward, and the skull lacks the peculiarly short-nosed appearance of *Mus*. In palatal aspect, the interpterygoid fossa is wider and more open, without the narrowing of the opposite walls seen in *Mus*. The incisive foramina extend back to the level of the molars. In tooth characters, the two groups are alike, both having the first upper molar large, equaling in length the combined lengths of the two others, while in profile view, the upper incisors are distinctive in having a square notch at the tip on the posterior side instead of being beveled off chisel-like. The first upper molar consists of the usual three cross-ridges, of which the first has three lobes, the innermost one slightly displaced backward; the second has all three lobes marked off in a trefoil form, its innermost lobe slightly displaced posteriorly; while the last cross-ridge consists of only the main central cusp and a small outer, for the inner cusp has disappeared. The second upper molar is similar, except that the first cross-ridge of the original three is represented only by minute remnants of the inner and outer cusps, the central one missing. The last upper molar is very small, nearly oval in crown outline and much more reduced, with remnants of two minute inner cusps and a large outer one which is apparently homologous with one of the central cusps of the fully developed tricuspidate ridges. The lower molars, as in *Rattus*, consist of paired cusps, three pairs in the first and two each in the second and third, those of the last minute. In addition, the first two teeth show a very small cingulum cusp in the middle of the posterior border.

In external characters these are small mouse-like animals with ears of medium size, tails varying from slightly more than head and body in some of the Asiatic species to much less than that dimension, as in most of the African members. The feet are strong in proportion, and narrow, the claws not specially developed, although some species are burrowers. Hitherto but a single species has been discovered in China, although several are found in the warmer parts of India. The generic name is from the Indian word *Legyáde* for *L. platythrix*, a spiny-haired species, but the genotype is *L. booduga* Gray.

415. *Leggada cookii cookii* (Ryley)

Mus cookii Ryley, Journ. Bombay Nat. Hist. Soc., vol. 22, p. 663, 1914.

Leggada cookii Thomas, Journ. Bombay Nat. Hist. Soc., vol. 26, p. 417, 1919. G. M. Allen, Amer. Mus. Novitates, no. 270, p. 5, 1927.

Type specimen.—An adult male, skin and skull, No. 13.11.18.2, British Museum, from Gokteik, North Shan States, Burma. Collected April, 1913, by Guy C. Shortridge.

Description.—General appearance much like that of a house mouse, but the under side slaty gray, the hairs gray-based and white-tipped, with a well-marked line of demarcation at the sides. General effect above, a light cinnamon-brown, brighter on the nape and flanks. The entire dorsal surface from

muzzle to base of tail is the usual mixture of black hairs with others having slaty bases and dull "tawny-ochraceous" tips, the former more numerous mid-dorsally and most concentrated in the posterior half of the back, which is distinctly blackish, while elsewhere the mixture is of about equal proportions, giving a distinctly tawny wash, brightest on the fore shoulders and on the flanks. Ears thinly covered with microscopic dark-brown hairs. Backs of the feet clad with pale whitish hairs, some of them with dark bases, and some nearly all dark, producing a dull grayish effect. Tail bicolor, dusky above, white below, without distinct line of division. Entire under surface of body and limbs grayish white, the bases of the hairs slate-gray, their tips dull whitish, with the faintest wash of buffy across the throat.

The skull is light and delicate, with the long rostrum characteristic of the genus and teeth as already described. The nasals extend as far back as the posterior ends of the premaxillaries, and there is a faintly marked supraorbital ridge extending back as far as the notch on the outer side of the parietal. The hinder end of the palate has a distinct median projection, and the interpterygoid fossa, although not noticeably narrowed, is not quite so wide as the shallow depressions on either side of it.

Measurements.—The tail slightly exceeds the length of head and body, and the foot is proportionately long, with slender toes, as the following field measurements indicate:

No.	Head and body	Tail	Per cent of total length	Hind foot	Ear	Locality
43817	82	88	51	21.0	15	Yunnan
43818	75	84	52	20.0	15	Yunnan
43819	70	75	51	18.5	15	Yunnan
43622	80	96	54	21.5	15	Yunnan

CRANIAL MEASUREMENTS OF *LEGGADA COOKII*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width outside molars	Upper cheek teeth	Lower cheek teeth	Locality
<i>L. cookii cookii</i>									
43622	—	—	11.5	—	—	4.6	3.6	3.7	Yunnan
<i>L. cookii meator</i>									
43592	22.7	19.4	11.7	11.4	10.2	5.0	3.7	3.5	Yunnan
43594	24.0	20.4	11.7	11.5	10.2	5.1	4.0	3.6	Yunnan
43615	24.0	20.2	11.5	11.6	10.5	5.1	3.7	3.7	Yunnan
84969	23.0	20.5	11.6	11.1	10.0	4.8	3.8	3.6	Yunnan
84982	23.3	19.7	11.5	11.0	10.9	5.1	3.8	3.2	Yunnan
43609 (type)	23.8	20.5	11.8	11.6	10.0	5.0	4.0	4.0	Yunnan
43608	22.2	19.2	11.2	10.7	10.0	—	3.9	3.4	Yunnan
43613	22.6	19.5	11.3	10.8	10.6	—	4.2	3.5	Yunnan
43616	22.8	19.2	11.4	11.7	10.0	—	4.0	3.6	Yunnan

Occurrence and Habits.—The typical race was described from Gokteik, northern Shan States, Burma, and I have identified with it four specimens from the Namting River on the Burmese¹ border of Yunnan. These specimens agree in being more brightly colored, with a more tawny or ochraceous tint than those from farther east at higher levels in Yunnan, so that I have described the latter as a distinct race. Possibly the typical form reaches other localities along the southwestern border of Yunnan, but at present no other records exist. It must be admitted that the reference of the specimens to *L. cookii* is somewhat tentative, but they agree best with Mrs. Ryley's description of that animal. Osgood has recorded *L. nitidulus annamensis* from Thateng, Indo-China, pointing out that *Tautatus* is a synonym of *Leggada* and quoting Thomas's notes to the effect that the animal described by Kloss as *Tautatus thai* from western Siam (Raheng) is probably the same as *Leggada cookii*, a conclusion that would considerably extend the known range to the southward.

Specimens examined.—The following four:

Yunnan: Namting River, Burma border, 4.

416. *Leggada cookii meator* G. M. Allen

Leggada cookii meator G. M. Allen, Amer. Mus. Novitates, no. 270, p. 6, 1927.

Type specimen.—An adult male, skin and skull, No. 43609, American Museum of Natural History, from Taipingpu, Shweli River, western Yunnan, 8,000 feet altitude. Collected April 9, 1917, by Dr. R. C. Andrews and Edmund Heller.

Description.—This upland race is much grayer above than the typical *L. c. cookii*, lacking the ochraceous tint to the upper surfaces. In other respects, however, it is practically the same. The dorsal surface from muzzle to tail and the sides are a nearly uniform drab or dark mouse-gray, resulting from a mixture of stronger slate-colored hairs with finer, dark-based hairs narrowly tipped with pale ochraceous. Ears thinly haired, dusky; feet whitish, their skin in dried specimens sometimes slightly darkened. Lower surfaces of head and body, the limbs and the tail, gray, not very sharply marked off from the color of the upper side, but with a fairly distinct line of separation, the hairs throughout pale gray at the base, their terminal half whitish.

The skull is not appreciably different from that of the typical race. The brain case is broad and oval, with a rather narrow interparietal produced slightly forward in the midline to a blunt point. Orbital edge square but not conspicuously thickened; outer corner of the parietals projecting forward as a tapering process, slightly overlapping the frontals. Nasals long, tapering posteriorly, ending about level with the posterior ends of the premaxillary processes.

Measurements:—The dimensions as taken from the fresh specimens are here entered from the labels, including the largest of eighteen:

No.	Head and body	Tail	Per cent of total length	Hind foot	Ear	Locality
43592	80	92	53	21.0	14	Yunnan
43594	87	84	49	20.0	14	Yunnan
43595	90	85	48	21.0	15	Yunnan
43609 (type)	87	80	48	20.0	14	Yunnan
43613	84	77	48	22.0	16	Yunnan
43614	95	84	47	20.0	16	Yunnan
43615	85	83	49	20.5	14	Yunnan
43620	85	95	52	21.0	14	Yunnan
43623	81	88	52	21.0	15	Yunnan
44450	80	88	52	21.5	14	Yunnan

For cranial measurements, see table under the typical race.

Occurrence and Habits:—The specimens from higher levels in western Yunnan on which this race is based are uniformly duller and grayer than those taken at the Burma border at an elevation of about 1,700 feet. Both series are in winter pelage and thus are quite comparable, those of typical *L. c. cookii* having been taken in February and March, those of *L. c. meator* in January, February and April. The following localities are represented in the series of eighteen specimens secured: Taipingpu on the Shweli River, 8,000 feet; Homushu Pass, 8,000 feet; Shasungshoo, Mekong drainage, 7,500 feet; Tashuitang, Salween drainage, 6,000 feet; Yangpi River, 5,000 feet; and near Yunnanfu. One of the latter is from a field near a village. This mouse does not apparently enter houses and become a hanger-on of man.

Mell (1922) records "*Leggada fulvidiventris* Gray" from the mountains on the north border of Kwangtung, but exactly what species is intended or whether the genus occurs in China elsewhere than in the extreme southwestern corner are points to be determined as later opportunity arises.

Specimens examined:—The following twenty-six:

Yunnan: Homushu Pass, 4; Makaihsien, 1; Shasungshoo, Mekong drainage, 3; Taipingpu, Shweli River, 6; Tashuitang, 2; Yangpi River, 1; Yangpifu, 1; Yunnanfu, Kaochiao, 8.

Genus *Mus* Linnæus

Mus Linnæus, Syst. Nat., ed. 10, vol. 1, p. 58, 1758. W. L. Sclater, Mamm. So. Africa, vol. 2, p. 37, 1901 (type fixed). Miller, Cat. Mamm. Western Europe, p. 863, 1912.

Even up to the time of Trouessart's new edition of his "Catalogus Mammalium" in 1904, the genus *Mus* included a large and diverse assemblage of Old World species, which in later years has been separated into smaller related groups and these gradually given generic or at least subgeneric rank. As at present constituted, it is typified by the common house mouse, *Mus musculus*,

and a few related species chiefly of the Palæarctic region and the north temperate zone. By many writers it is still used to include *Leggada* as a subgenus, but, as pointed out by Thomas (1919), the specialized character of the rostrum, which in typical *Mus* is much shortened, may be used to distinguish it. A description of the generic characters of *Mus* (including *Leggada*) has been given by Miller (1912), who calls attention especially to the elongation of the first molar, the length of which slightly exceeds the combined lengths of the two other molars; the notched upper incisor, due to the angle at which the teeth are set; and the backward displacement of the internal cusp of the cross-ridges in the two anterior upper molars. Otherwise the arrangement of the tubercles in these teeth is much as in *Rattus*. The mammae are: 3 pairs pectoral, 2 pairs abdominal, or ten.

The genus *Mus* as here defined includes but two chief types of mice, the common house mouse (*Mus musculus*), and a smaller species, *M. bactrianus*, which with several subspecies ranges from Spain to eastern China, and is represented in Europe by *M. b. spicilegus*. Both species occur in China, the former through introduction, while the latter, as in other parts of its range, is agrarian and is represented by native races.

KEY TO THE CHINESE AND MONGOLIAN FORMS OF *Mus*

- A. Larger, skull usually 20-23 mm. long; hind foot with claws, 18 mm.; tail not bicolor, feet dull or dusky..... *Mus musculus* (introduced)
- B. Smaller, skull about 19-20 mm. long; hind foot with claws 16-17 mm.; tail bicolor, feet white..... *Mus bactrianus* races
 - a. Tail considerably shorter than head and body, 39-42 per cent of total length, belly hairs white to their bases.
 - a'. Upper side uniform pale sandy buff..... *M. bactrianus gansuensis*
 - b'. Back darker in the middle than at the sides..... *M. bactrianus manchu*
 - b. Tail nearly equaling or exceeding head and body; belly hairs gray-based.
 - a'. Tail about 46-50 per cent of total length; a buffy collar usually present on the throat..... *M. bactrianus tantillus*
 - b'. Tail about 53 per cent of total length, throat white.... *M. bactrianus kakhyenensis*

417. *Mus musculus* Linnæus

COMMON HOUSE MOUSE

Mus musculus Linnæus, Syst. Nat., ed. 10, vol. 1, p. 58, 1758.

Mus musculus sinicus Cabrera, Bol. Real Soc. Esp. Hist. Nat., Madrid, vol. 22, p. 166, 1922. Ningpo, Chekiang.

Type specimen.—If a type specimen ever existed, it was doubtless never preserved. The type locality is assumed to be southern Sweden.

Description.—General color above, a mixture of black and ochraceous in such proportion as to give a dull tawny-gray appearance, slightly darker in the

mid-dorsal area and shading gradually into the somewhat clearer tawny ochraceous of the sides. This color in turn passes by imperceptible degrees into the buffy of the belly. The hair of the ventral surfaces everywhere is slaty gray at the base, tipped with buffy on the chest and abdomen, while the throat is nearly clear gray. Backs of the feet gray to dusky, the toes often whitish. Tail dark above and only slightly paler below, to dull whitish, without sharp line of demarcation.

The general characters of the skull have already been mentioned, with its very short rostrum, and diverging supraorbital ridges which are low and extend as raised lines to the notch on the outer side of the interparietal. The interparietal is large, with a median blunt point on both anterior and posterior outlines. The incisive foramina are long, extending back to the level of the middle of the first molar. The interpterygoid fossa is narrow, its sides nearly parallel, and much less in width than the wide valley on each side of it. The upper incisors curve backward at such an angle that the lower incisors wear out a square notch on the posterior side instead of the usual beveled edge. The last upper molar is very small, and the first is so large in proportion that its length equals or slightly exceeds the combined lengths of the two others. The cusps of the molars when unworn are high and clear-cut, with the innermost cusp of the first two cross-ridges of m^1 compressed and much displaced backward, so that it is on a level with the main cusp of the succeeding cross-ridge. The third cross-ridge of this tooth has no inner cusp, so that there are an outer and a central longitudinal row of three cusps each and an inner one of but two. The second upper molar retains only the innermost cusp of the first cross-ridge, but what corresponds to the second is complete and resembles that of the anterior tooth, with its inner cusp lobe-like and deflected backward; the third cross-ridge consists of the central and outer cusps only. The last upper molar is very small and its elements obscure, but with indication of two cusps on the inner side and one on the outer.

Measurements:—A specimen from Massachusetts measured in the flesh: head and body, 82 mm.; tail, 81; hind foot, 18.5; ear, 13. The type of Cabrera's *M. m. sinicus* from Ningpo measured: head and body, 72 mm.; tail, 79; hind foot, 17; ear, 10; skull, condylo-incisive length, 19.

CRANIAL MEASUREMENTS OF *MUS MUSCULUS*

No.	Greatest length	Basal length	Palatal length	Zygomastic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
3002 MCZ	21.3	18.0	10.8	11.0	9.2	4.1	3.5	3.1	Louisiana
3003 MCZ	19.6	16.5	9.8	9.5	9.0	4.4	3.2	3.1	Louisiana
3004 MCZ	23.0	19.9	11.7	12.0	10.0	4.8	3.7	3.5	Louisiana
3005 MCZ	20.6	17.6	10.5	10.8	9.3	4.3	3.2	3.0	Louisiana
3006 MCZ	20.8	18.3	11.0	11.1	9.8	4.6	3.5	3.1	Louisiana

The tail is usually slightly less or slightly more than the head and body length, the hind foot seldom less than 17 mm.

The measurements of five skulls from southern United States are given above to indicate the variation in dimensions.

Nomenclature.—It seems probable that the mouse described by Cabrera as *Mus musculus sinicus* is, after all, not different from the common house mouse. The hind foot is 17 mm., as in many specimens. Possibly, however, it is the same as *Mus bactrianus kakhynensis* and should stand as a synonym of it.

Occurrence and Habits.—The common house mouse shows a fondness for the shelter and available food afforded by human habitations, and is in most of its range a parasite of man, although frequently individuals wander far from dwellings and may behave quite like a normal wild species. They hide in baggage and are easily transported from place to place, and being prolific animals, lend themselves readily to colonization. During the last two centuries, with trading by sea and by land all over the globe, this little species has been introduced from Europe almost everywhere that human populations, especially white, are found. So thoroughly has this distribution been accomplished that it is difficult at present to ascertain with any reasonable certainty exactly what the original bounds of its normal range may have been. Probably in ancient times it was confined to north temperate Europe and southwestern Asia, not extending much farther east than Persia and possibly northeastern India. In the southern part of this range it may have met and overlapped the range of the smaller species, for which the oldest name seems to be *Mus bactrianus*, represented in southern Europe by *Mus bactrianus spicilegus* and one or two related races. This smaller species is very little given to living in houses, but keeps usually to fields and open country, occurring all the way across central Asia to China and Mongolia, breaking up into several recognizable races. It is not impossible that where the ranges of the two species now overlap, they hybridize, giving rise to some of the white-bellied forms, for the common house mouse is gray and buffy below, while the other species is either pure white to the roots of the hairs on the under side, or at most only the bases of these hairs are gray and the tips white. On the other hand, Schwarz has lately considered all as representing a single species.

No doubt the common house mouse has been introduced into many parts of China, as at the seaports and along trade routes, so that by now many colonies are well established. Since the native races of *M. bactrianus*, the only nearly related species in China, are seldom house-living, there is probably less competition for living quarters than there is between native and introduced rats, so that colonies are possibly easier to establish. Swinhoe in 1870 wrote

that house mice, "probably introduced," were occasionally seen in the houses of South China and Formosa, and mentions that black and white varieties are often kept by the Chinese, but these, no doubt, are varieties of *M. bactrianus*. At Yenping, Fukien, the introduced species is common. A series was taken by the American Museum collectors there, and Professor Claude Kellogg has sent me four from Foochow. Cabrera (1922) gave a new name—*M. m. sinicus*—to what appears to be a specimen of this species from Ningpo, Chekiang. Mell (1922), speaking of the vicinity of Canton, Kwangtung, wrote that he had known of five specimens only in the course of several years' residence, and these were all taken in the city, two trapped in his house, and three others brought in. Weigold saw three trapped in Fongdsun, south of Pearl River, and H. Stevens caught nine at Nguluko, Yunnan. A single one from Likiang, 9,000 feet altitude, Yunnan, was brought back by Dr. R. C. Andrews. Other than these, I have no certain records of its occurrence in the whole of China, though undoubtedly it is established in many of the larger centers. It is interesting in this connection that Dr. Fortuyn, while residing at Peiping and desiring specimens of the European House Mouse alive for cross-breeding experiments, was unable to obtain them there, for apparently the native form, which is practically identical with *M. b. gansuensis*, is the one established in this district.

Specimens examined:—The following twenty-one:

Fukien: Yenping, 15; Foochow, 5 (M.C.Z.).

Yunnan: Likiang, 9,000 feet, 1.

418. *Mus bactrianus gansuensis* Satunin

Mus (Leggada) gansuensis Satunin, Annuaire Mus. Zool. Acad. Imp. Sci. St. Pétersbourg, vol. 7, p. 564, 1902.

Mus wagneri mongolium Thomas, Proc. Zool. Soc. London, 1908, p. 106. Tabool, Mongolia.

Mus gansuensis Thomas, *ibid.*, p. 641.

Mus wagneri Fortuyn, Bull. Peking Soc. Nat. Hist., vol. 3, p. 59, 1929 (in part).

?*Mus batrianus longicauda* (*sic*) Mori, Rept. First Sci. Exped. to Manchoukuo, sect. 5, div. 2, pt. 4, p. 76 (English), pl. 15, text figs. 22, 23, March, 1939. Chaoyang, Jehol.

Type specimens:—The description is based on two specimens in the collection of the Zoological Museum of the Academy of Sciences at Leningrad, which are therefore cotypes. One is an adult female, skin and imperfect skull, from Tschortentan Temple, Kansu, China; the second is a young but nearly full-grown individual from the Chitschju River of the Yangtze system in the same province. Both were collected by the Russian explorer Kozlov.

Description:—Size of a small house mouse, but tail distinctly shorter than head and body, forming about 42 per cent of total length; colors very pale.

General color of the body above, a pale sandy buff, not darkened in the mid-dorsal region; ears like the surrounding parts; upper side of the tail sandy gray, its lower side whitish; feet whitish. Entire under parts, as well as the upper lips and forearms, white to the roots of the hairs, except at the sides where they develop slaty-gray bases.

The skull is closely similar to that of *M. musculus*, with the same shortened rostrum, long incisive foramina extending back to the level of the middle of the first molar, zygomatic plate convex forward, the pterygoid fossæ wide and shallow, and the interpterygoid fossa narrowed. Usually the last has an evenly arched or slightly U-shaped outline, rarely with a trace of a median projection from the edge of the palate, while in *M. musculus* it is common to find such a projection.

A comparison of somatic characters of these two species has been made by Fortuyn (1929, 1931, 1931a), using specimens of *M. b. gansuensis* from Hopei. He finds that the short-tailed race represented by wild-caught specimens of this mouse from near Peiping not only has fewer tail-rings (averaging about 138 against 197 in *Mus musculus*), but that the number of tail vertebræ is also less, as had previously been shown by Gates, using the tame albino variety of *M. bactrianus* subsp. Thus Gates found that the tail vertebræ in the latter range from 19-20 in wild stock and from 21-22 in the tame, as against 26-28 in *M. musculus*. In a comparison of body weight, which indicates bulk as well, the *M. bactrianus* ("*wagneri*") type was about two-thirds the weight of *M. musculus* in individuals which appeared comparable as to age.

Measurements.—In this race the tail is shorter than the head and body combined, averaging about 40 per cent of the total length. The foot with claws is usually noticeably less in length than in *M. musculus*, not exceeding 17 mm. and usually a trifle less, as the following table shows.

No.	Head and body	Tail	Per cent of total length	Hind foot	Ear	Locality
59774	77	52	40	15.0	14.0	Mongolia
59775	76	50	39	17.0	11.0	Mongolia
59776	66	48	42	15.0	11.0	Mongolia
84095	71	47	40	16.0	12.0	Mongolia
84220	58	40	40	16.0	9.0	Mongolia
85217	70	58	44	16.0	11.0	Mongolia
(type of <i>M. w. mongolium</i>)	82	50	38	15.5	12.5	Mongolia
(type of <i>M. gansuensis</i>)	73	54	42	16.5	15.0	Kansu
8.3.5.32 BM	73	56	43	16.0	12.5	Mongolia
8.3.5.34 BM	75	54	42	15.0	12.0	Mongolia

For cranial measurements, see the table following.

CRANIAL MEASUREMENTS OF *MUS BACTRIANUS*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
<i>M. bactrianus bactrianus</i>									
56.2.29.4 BM (cotype)	21.5	19.2	11.5	11.5	9.6	4.6	3.2	2.9	Afghanistan
<i>M. bactrianus gansuensis</i>									
8.3.5.33 BM	20.5	18.5	10.3	11.1	9.6	4.6	3.1	2.6	Mongolia
8.3.5.36 BM (type of <i>M. w. mongolium</i>)	20.8	18.5	10.7	11.1	9.4	4.5	3.1	3.0	Mongolia
8.3.5.37 BM	20.0	17.4	10.5	10.5	9.1	4.5	3.3	3.0	Mongolia
9.1.1.96 BM	20.0	18.1	10.7	11.5	9.5	4.6	3.3	2.9	Shensi
9.1.1.97 BM	22.4	19.9	11.7	11.5	9.8	5.0	3.1	3.0	Shensi
25870 MCZ	19.8	17.3	10.5	—	9.1	4.5	3.3	3.0	Shantung
25871 MCZ	20.1	17.7	10.4	—	9.3	4.4	3.1	2.8	Shantung
25895 MCZ	20.1	17.2	10.0	10.7	9.6	4.5	3.0	2.9	Shantung
<i>M. bactrianus tantillus</i>									
32292	20.0	17.2	10.0	10.5	9.3	—	3.5	3.0	Shensi
32293	19.0	16.8	9.8	—	8.5	—	3.4	3.0	Shensi
32294	19.0	16.0	9.5	10.2	9.0	—	3.5	3.0	Shensi
56401	19.0	16.6	9.4	10.4	9.8	—	3.5	3.0	Shensi
56403	20.5	17.3	10.0	11.0	9.2	—	3.4	3.0	Shensi
56413 (type)	20.0	17.0	10.3	10.9	9.0	—	3.5	3.5	Szechwan
7154 MCZ	19.9	17.3	10.2	10.1	9.6	4.3	3.1	2.5	Hupeh
<i>M. bactrianus manchu</i>									
8.8.7.54 BM	20.8	17.9	10.4	11.6	9.8	4.7	3.2	2.7	Hopei
8.8.7.55 BM	20.5	17.8	10.4	11.5	9.9	4.2	3.1	2.7	Hopei
10.5.1.57 BM	20.3	—	10.5	10.8	9.7	4.5	3.2	2.7	Manchuria
56399	19.5	16.7	9.4	10.6	8.5	—	3.0	3.0	Hopei
<i>M. bactrianus kakhyenensis</i>									
43621	19.0	16.5	9.9	—	9.0	—	3.6	3.6	Yunnan
43637	21.5	18.8	11.0	11.0	9.0	—	3.7	3.8	Yunnan
43638	19.0	16.0	9.4	9.5	8.8	—	3.6	—	Yunnan
43639	21.0	19.0	11.0	11.0	8.8	4.3	3.5	3.4	Yunnan
58918	21.7	19.6	11.8	—	9.4	—	3.4	3.0	Hainan
58936	20.1	17.0	10.1	10.2	9.6	4.2	3.3	3.1	Hainan
58937	20.3	17.2	10.6	—	8.9	3.8	3.3	3.2	Hainan
58956	20.1	19.0	10.2	10.5	8.6	4.3	3.1	2.9	Hainan
58964	20.2	17.5	10.3	9.7	8.9	4.1	3.1	3.0	Hainan

Nomenclature.—The small mice of this species have been given various names, of which *M. wagneri* Eversmann, 1848, is perhaps the best known, although topotypical specimens are few in collections. Apparently, however,

Mus bactrianus Blyth, 1846, is the oldest name that can be certainly shown to apply to this species, the type locality of which is the desert country of Kandahar in Afghanistan, not the place of the same name in Hyderabad, India. From time to time other names have been given to other races, without taking into consideration that the animals are slightly varying forms of a single species, ranging from western Europe across central Asia to the Pacific coast of China. Of the European races, the animal hitherto known as *Mus spicilegus*, but which should stand as *Mus bactrianus spicilegus*, extends from southern Sweden across east-central Europe, with a race *hispanicus* in Spain, and *lusitanicus* in Portugal. Probably *Mus wagneri* from southeastern Russia and Turkestan is a synonym of *Mus bactrianus*, which thus covers a wide area in central Asia, chiefly in desert country. In the Gobi and North China the still paler race *M. b. gansuensis* is found, which ranges west to the Tien Shan. The specimens from Djarkent in the British Museum are appreciably redder, and are seemingly identical with *Mus bactrianus*, while to the southeast a longer-tailed race covers most of southern China. Specimens are often difficult to tell from similarly pale *Mus musculus* where the two occur together in southwestern Asia, and it may be that in Mediterranean localities the two frequently hybridize as they readily do in captivity, producing intermediates, some of which are identified as *M. b. gentilis* or *M. b. orientalis*. This is perhaps slight evidence that, previous to its sporadic introduction by man, *Mus musculus* was a larger, darker species (hind foot 17-19 mm., skull length usually 21 mm. or over when fully grown) found from western Siberia across northern and central Europe, while *M. bactrianus* (hind foot 17 mm. or less, skull less than 21 mm.) was more southern in distribution, from southern Europe across central Asia. *Mus musculus* readily associates itself with man, becoming a "house mouse," but *M. bactrianus* is more agrarian, though often coming into dwellings or granaries.

Various artificial breeds have been established, such as black, albino and "spotted." The so-called waltzing mice, supposed to have originated in Japan, and now much used in genetical studies, are undoubtedly derived from some one of the eastern races of this mouse, and have been named by Fortuyn "var. *rotans*." This name is probably to be regarded as a synonym of *M. b. gansuensis* on the basis of tail-ring counts, or perhaps of *M. b. manchu*, both of which antedate it. There seems to be no doubt also that the Mongolian race which Thomas named *Mus wagneri mongolium* is the same as *M. bactrianus gansuensis*. Finally, Mori has lately described a new race, *M. b. longicauda*, from Chaoyang, Jehol, which is said to differ chiefly from *gansuensis* in having the tail about equal in length to head and body, instead of shorter; since, however, the type is a young adult in alcohol, and may be somewhat shrunken in consequence, it is for the present regarded as representing *M. b. gansuensis*.

Occurrence and Habits:—The pale colors and pure white belly, as well as the short tail, characterize this race of the arid country of North China and the Gobi. In the northeast, specimens from about Peiping are fairly typical, with a tendency to darken above, and so grade into the Manchurian race, *M. b. manchu*, in northeastern Hopei. In the dry country of Shantung, Shansi, and Shensi, the same pallid animal occurs, while still farther west, specimens from southern Kansu, as at Choni, are not distinguishable. In the Gobi Dr. Andrews found it at such remote spots as Ula Usu, Gun Burte, and Tsagan Nor, while others were secured around Mongol camps and villages on the plateau along the caravan trail north of Kalgan. At Fenchowfu, Shansi, and near Yulinfu, Shensi, Sowerby and others found them living as wild species in fields, on riverbanks, or on hillsides. About Peiping and no doubt elsewhere they come freely into houses, but seem to prefer fields. In Shansi they are also common in such situations and often congregate about the threshing floors of the peasants. Specimens from southern Shensi, as south of Fengsiangfu, are intermediate between this race and *M. b. tanillus* which tends to have a buffy wash on the throat and chest. A female from the latter locality contained four embryos (November 28, 1910). Others from the Shangchow district of southeastern Shensi are placed here, and Clark and Sowerby (1912) mention one taken on a hillside on very barren ground near Sianfu, Shensi. Thomas (1911d) records specimens from ten miles south of Taochow, Kansu, and there are others from near Choni in the same province in the Museum of Comparative Zoölogy. These latter are practically typical.

In a recent paper C. V. Green (1932) has published some interesting notes on the breeding habits of this mouse in captivity. The specimens were taken near Peiping and brought to Michigan for study. Though wild at first, the behavior of successive captive generations gradually became less restive, and they could eventually be handled like laboratory stock of *M. musculus*, with which they interbred freely and produced fertile offspring. No definite breeding cycle was shown, but the mice bred freely throughout the year in rooms at about 70° F. The litters, however, averaged smaller than those of the latter species, the mean for 180 litters being about 4.4. The females were found to bear their first litters at a considerably greater age than was the case in *M. musculus* females of an inbred strain. Thus the average age of females giving birth to their first litter was about 177 days (57 cases), whereas in the latter species it was only about 102 days. Like the common house mouse, females were often in heat within twenty-four hours after the birth of a litter, and the period of gestation is the same, twenty days, when not lengthened by nursing of a previous litter. The first litter is usually smaller than the second or third. Some females continue to breed to a ripe old age, in one case a female bearing two when 568 days old, while one at the age of 648 days produced two young.

The span of life was found to be rather longer than in *M. musculus*, the oldest one being a male that lived nearly three years, or 1,032 days.

Specimens examined.—The following forty-one:

Mongolia:

Bailing Miao-Hami road, 1; Tsagan Nor, 3; east end of Lan Shan, 1; Gun Burte, 1; Ula Usu, 1; Tabool, 4, including type of *M. wagneri mongolium* (B.M.).

China:

Hopei: Peiping, 1 (M.C.Z.); fifteen miles east of Peiping, 2 (M.C.Z.).

Shantung: Tsinan, 2 (M.C.Z.); northern part, 1 (M.C.Z.).

Shansi: Taiyuan, one hundred miles north, 6 (B.M.); Fenchowfu, thirty miles west, 1 (B.M.); Yirgo, 8 (M.C.Z.).

Shensi: Yulinfu, 2 (B.M.); Shangchow, 1 (B.M.); southern part, 1 (B.M.).

Kansu: Choni, 3 (M.C.Z.); Taochow, ten miles south, 2 (B.M.).

419. *Mus bactrianus manchui* Thomas

Mus wagneri manchui Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 4, p. 502, 1909.

?*Mus wagneri* var. *rotans* Fortuyn, Zool. Anzeiger, vol. 39, p. 177, 1912 (the waltzing mouse).

Type specimen.—An adult female, skin and skull, No. 10.5.1.57, British Museum, from Chuchiatai, near Changchun, Kirin, Manchuria. Collected August 22, 1908, by Alan Owston.

Description.—In size and proportions the northeastern race of this mouse resembles *M. b. gansuensis*, but the back is very much darker, due to the abundance of all-black hairs in the central dorsal area, so that when series of both are laid out together they may be separated at once by the contrastingly blackish backs. The under surfaces are usually white, the hair of the central portions of the belly white to the roots, although in the type the roots are gray-based even here.

The skull is as in the race *M. b. gansuensis*.

Measurements.—The tail is relatively short, as in the previous race, averaging about 42 per cent of the total length, and in other proportions the two hardly differ. The following are from fresh specimens:

No.	Head and body	Tail	Per cent of total length	Hind foot	Ear	Locality
10.5.1.57 BM (type)	85	56	40	16.5	—	Kirin
8.8.7.52 BM	77	58	42	15.0 (s.u.)	12.0	Hopei
8.8.7.53 BM	75	63	44	15.5 (s.u.)	12.0	Hopei
8.8.7.54 BM	77	60	43	14.5 (s.u.)	13.0	Hopei
8.8.7.55 BM	71	63	46	14.0 (s.u.)	11.5	Hopei
8.8.7.56 BM	76	58	43	15.0 (s.u.)	12.5	Hopei

Measurements of skulls from China referred to this race are given in the table under *M. b. gansuensis*.

Occurrence and Habits.—Intergradation between this dark-backed race and the much paler *M. b. gansuensis* of the more arid country to the southwest takes place in central Hopei. Specimens taken at Peiping and slightly to the eastward are nearly indistinguishable from the latter, but to the north and northeast they gradually darken over the lower back and develop gray bases to the white hairs of the central abdominal region, so that specimens from the Eastern Tombs, sixty to one hundred miles northeast of Peiping, are on the whole better referred to *M. b. manchu*, with occasional individuals that are as near *M. b. gansuensis*. Probably the animal of the northeastern part of Hopei and along the Manchurian border is as dark as the usual *M. b. manchu*. No doubt, too, there is more or less transportation of these little commensals by caravan along the trade routes to Peiping and Mongolia from the east. What seems to be evidence of this is seen in an interesting series in the British Museum taken at the edge of the Mongolian grasslands, one hundred miles northwest of Kalgan on the route to Urga. One of these is as dark as typical *M. b. manchu* and probably is a waif, while some are intermediate, and others as pale as the local desert race.

One of the series from the Eastern Tombs contained nine embryos, one less than the number of mammæ, giving a hint of the prolificness of this mouse.

Specimens examined.—In addition to the type and others and excluding more or less intermediate examples from about Peiping, the following may be referred to this race:

China:

Hopei: Eastern Tombs, 5 (B.M.), 1 (A.M.N.H.).

Mongolia:

One hundred miles northwest of Kalgan, 1 (B.M.), probably an immigrant.

420. *Mus bactrianus tantillus* G. M. Allen

Mus bactrianus tantillus G. M. Allen, Amer. Mus. Novitates, no. 270, p. 9, 1927.

Type specimen.—An adult female, skin and skull, No. 56413, American Museum of Natural History, from Wanh sien, Szechwan, China. Collected November 14, 1921, by Dr. Walter Granger of the Central Asiatic Expeditions.

Description.—A somewhat darker race, with gray-based belly hairs and a longer tail than the more northern *M. b. gansuensis*, and usually with a buffy throat. The color above is sandy, resulting from a mixture of buffy-tipped with all-black hairs, the latter more numerous over the rump, and the buffy-tipped hairs brighter, more nearly ochraceous buff than the pale buff of *M. b. gansuensis*. Sides clearer ochraceous buff. Below, the hairs are gray-based with pure-white tips, except at the wrists where they are all white. Throat with a buffy collar, and in some specimens a suffusion of buffy may extend to

most of the under side. Ears dusky, nearly naked. Backs of the hind feet dusky, under a lens seen to be covered with a mixture of pale brownish and whitish hairs; toes whitish. Tail indistinctly bicolor, the upper side blackish brown, the lower side with mostly white hairs but the skin partly pigmented.

The skull is not appreciably different from that of the northern race.

Measurements.—In this race the tail is longer in proportion than in the desert and arid-country races to the north, averaging about 49 per cent or barely half of the total length. The feet and ears, however, are of much the same size. The following measurements are from fresh specimens:

No.	Head and body	Tail	Per cent of total length	Hind foot	Ear	Locality
56407	74	71	49	15.0	11.0	Szechwan
56409	77	68	47	16.0	13.0	Szechwan
56410	66	65	49	15.0	12.0	Szechwan
56413 (type)	65	66	50	17.0	11.5	Szechwan
56414	61	59	49	15.0	11.0	Szechwan
56416	78	70	47	15.0	12.0	Szechwan
56419	68	59	46	15.5	11.0	Szechwan
56404	78	60	43	18.0	14.0	Shensi

For cranial measurements, see table under *M. b. gansuensis*.

Occurrence and Habits.—This buff-throated race is somewhat intermediate in tail length between *M. b. gansuensis* and *M. b. kakhynensis* but differs from the former in having a somewhat brighter and darker coloring above, with the belly hairs gray at their bases instead of pure white throughout, and in having a proportionally longer tail. From the latter it differs in having the tail less elongate, and in the usual presence of a buffy throat or even a buffy suffusion of the entire under parts. In the latter condition it somewhat resembles a house mouse, *Mus musculus*, but may be distinguished by its smaller hind foot and skull. It was such a specimen that I earlier (G. M. Allen, 1912) recorded as of the latter species from Ichang, Hupeh, but which on further examination proves to be an example of the present race, here no doubt at about its eastern limit. The series from the type locality, Wanh sien, eastern Szechwan, still farther west, is apparently the first to be recorded from this province, for other collections from the higher altitudes do not include it. One may infer, therefore, that the buff-throated race is characteristic of the moister country along the foothills of western China, from Hupeh and eastern Szechwan northward to the base of the Tsingling Range in extreme southern Shensi, and westward to southeastern Kansu whence the American Museum Asiatic Expeditions obtained one from Machu, that has the entire under parts buffy like the Ichang specimen. The few that I have seen from the Tsingling, Taipai Shan, are really intermediate, with pure white bellies, but with longer tails and slightly darker

backs than those of the drier country immediately to the north, referred to *M. b. gansuensis*, while those from central and northern Kansu are again of the latter race.

Specimens examined.—The following fourteen:

Szechwan: Wanh sien, 8 (including type).

Hupeh: Ichang, 1 (M.C.Z.).

Shensi: Taipai Shan, 4.

Kansu: Machu, 1.

421. *Mus bactrianus kakhyenensis* Anderson

Mus kakhyenensis Anderson, Anat. and Zool. Researches Western Yunnan, p. 307, 1879.

Mus viculorum Anderson, *ibid.*, p. 308. Sclater, Proc. Zool. Soc. London, 1890, p. 539. Ponsee.

Mus kakhyensis Sclater, *loc. cit.*

Mus urbanus Sclater, *loc. cit.* (in part?).

Mus bactrianus kakhyenensis G. M. Allen, Amer. Mus. Novitates, no. 270, p. 9, 1927.

Type specimen.—The type specimen was secured in the Kakhyen Hills, near the border of Burma and China, at Ponsee, by Dr. John Anderson in the course of his journey to western Yunnan, probably in 1868. It is in the Indian Museum at Calcutta, where it was examined by Dr. W. L. Sclater (1890), who at the same time compared with it the type of Anderson's *Mus viculorum* from the same place and declared it identical.

Description.—A long-tailed race, darker colored than those of the arid regions of northern China and Turkestan. The rather short fur (4-5 mm. in middle of back) is of the usual mixture of black and buff-tipped hairs above, but the former are sufficiently abundant to give a dark "mouse color" over the back, becoming clearer, nearly ochraceous buff, on the sides, closely similar to that of the European House Mouse. Lower surface of the body and limbs with the hairs gray at base, tipped with dull whitish, except that the forearms and throat are nearly clear whitish, lacking the gray bases. Backs of the feet white. Ears small and thin, their substance dusky brown, with scattered minute brownish-black hairs on the proëctote, and mixed blackish and pale gray hairs on the metentote. The tail is slender, bicolor, dusky above, including both the scales and the scanty minute hairs, while on the under side both these are white, with a fairly sharp line at the sides delimiting the dorsal and ventral parts. Occasional individuals show a faint buffy tinge over the under parts of the body.

The small skull is of the same size and proportions as in other races.

Measurements.—The relatively long tail, more than the combined length of head and body, is characteristic of this race, but the feet and ears remain small. The following measurements are from fresh specimens as taken by the collectors:

No.	Head and body	Tail	Per cent of total length	Hind foot	Ear	Locality
43621	63	73	53	17	13.0	Yunnan
43637	70	78	52	18	13.5	Yunnan
43638	62	76	55	17	13.5	Yunnan
43639	75	82	52	18	14.0	Yunnan
43644	65	80	55	18	14.0	Yunnan
58927	77	85	52	18	13.0	Hainan
58930	77	83	52	17	13.0	Hainan
58932	66	71	51	16	12.0	Hainan
58980	78	80	51	17	12.0	Hainan
58933	77	83	52	17	13.0	Hainan

In Fukien, the tail measurement begins to vary toward the condition in the northern races, and although usually longer than head and body, is occasionally subequal to it or even shorter, if the collectors' measurements may be trusted, as the following show:

No.	Head and body	Tail	Per cent of total length	Hind foot	Ear	Locality
84706	80	77	49	17.0	12	Fukien
84707	70	70	50	17.0	12	Fukien
84710	80	85	51	18.0	12	Fukien
84719	84	76	47	18.0	15	Fukien
84722	75	84	52	18.5	13	Fukien
84733	71	70	49	16.0	15	Fukien
84734	70	75	51	16.0	12	Fukien
84735	81	78	49	16.0	11	Fukien
84736	80	78	49	17.0	13	Fukien
84744	71	80	53	16.0	13	Fukien

Cranial measurements are given in the table under *M. b. gansuensis*.

Occurrence and Habits.—This long-tailed, gray-bellied race is common in southern China, and is at once distinguished from the European House Mouse by its more delicate form, clearly bicolor tail and white belly. Although its close relationship to *M. bactrianus* is undoubted, it may still be a question whether or not some one of Hodgson's many names is not applicable to it rather than the one given by Anderson. Sc Slater in 1890 regarded both this and Anderson's *M. viculorum* as synonyms of Hodgson's *Mus urbanus*, but the latter's descriptions are largely unidentifiable without his specimens or topotypes from the region of Nepal. Nevertheless, it may be that *M. urbanus* will eventually prove to be the oldest name for a mouse of this species, so that *M. bactrianus* will once more have to be retired. Until this can be shown, however, and since Anderson's description is explicit, it seems possible to use the name he gave.

In extreme southwestern Yunnan, at relatively low levels, perhaps up to

5,000 feet, this mouse is not uncommon. Anderson's specimens were from Ponsee, a point on the very border of China. Dr. R. C. Andrews found it scarce, however, at the places he visited on his way through this region, first meeting with it on the Yangpi River, Tengyueh road, at about 5,000 feet. Three were taken here, and one each at Yungchangfu, 5,500 feet, Hsinkai and Yuankiang, and two at Changlung, 2,000 feet, Salween River. No doubt further collecting will reveal its presence all along the extreme southern border of China, for Osgood (1932) has recorded specimens taken at various points in northern Indo-China. In southeastern China, however, it is again common. Thus at Futsing, Fukien, Mr. Clifford H. Pope secured a fine series, which, though varying slightly in the tail to total-length proportion, are in color quite like those from Yunnan. A single specimen was taken at Yenping in the more mountainous country. In Hainan Mr. Pope obtained a large series at Namfong and Nodoa which do not seem appreciably different and add the species to the list of mammals known from the island. Of the particular habits nothing is recorded, but it doubtless frequents clearings, fields and similar places in relatively low country, and, as elsewhere, becomes at times a house-haunting species, invading granaries, threshing floors or dwellings. No doubt it is often mistaken for the European House Mouse, but its whitish belly with gray-based hairs and the long bicolor tail will distinguish it. Specimens from north of Fukien in the Yangtze basin have not been seen, but should prove intermediate between this and the races *M. b. gansuensis* and *M. b. tantillus*.

From specimens lately received from Formosa, it now is apparent that the *Mus formosanus* of Kuroda is practically identical with this race, but possibly averages a slightly paler buffy on the back and sides. Were it not for the island habitat, this slight difference might be disregarded, but it may prove to be a distinguishing character.

Specimens examined.—The following one hundred and sixteen:

Yunnan: Yangpi River, 3; Yungchangfu, 1; Changlung, Salween River, 2; Hsinkai, 1; Yuankiang, 1.

Fukien: Foochow, 2; Futsing, 50; Yenping, 1.

Hainan: Namfong, 48; Nodoa, 7.

Genus *Rattus* Fischer

Rattus Fischer (misprint for *Rattus*), *Nationalmus*. *Naturg.* Paris, vol. 2, p. 128, 1803 (see Hollister, *Proc. Biol. Soc. Washington*, vol. 29, p. 126, 1916).

Mus of older and many recent authors, in part.

Epimys Trouessart, *Bull. Soc. d'Études Sci. d'Angers*, vol. 10, pt. 2, p. 117, 1881, and later editions of *Cat. Mamm. Viv. Foss.*

The name *Rattus* was first proposed by Frisch in 1775, but his work (*Das Natur-System vierfüss. Thiere*) turns out to be not strictly binomial, hence his

new name is ruled out. The next author to use *Rattus* is J. B. Fischer, in 1803, from whom therefore the name is cited. Hollister (1916) fixes the type species as *Mus decumanus* Pallas, 1778, which is antedated by *Mus norvegicus* Erxleben, 1777.

As at present constituted, *Rattus* includes a number of medium-sized to larger species, which in most early and even in many recent classifications were placed under the general name *Mus*, but are now recognized as a distinct group. The typical rats are native to the Old World, chiefly the tropical and subtropical parts of Asia and northern Africa, with a few species extending into the north temperate zone. Most of them are Asiatic, for most of the African groups formerly included with them, and doubtless closely related, are now placed in slightly marked genera of their own. The genus *Rattus* is characterized mainly by the simpler structure of the teeth and the lack of any special modifications of the limbs, feet, or tail. The upper incisors as seen in profile are bevel-edged instead of notched as in *Mus*, and the second and third molars are less reduced, exceeding in their combined length the length of the first molar. The essential structure of the molars consists of three cross-ridges of three forwardly convex tubercles each. In the first upper molar, all three cross-ridges have a large central tubercle extending slightly ahead of the inner and outer tubercle of its ridge, but the inner one of the third or posteriormost ridge is not clearly developed as a separate lobe such as one sees in *Apodemus*, but is usually much reduced, forming a slight lateral extension of the main lobe. In the second upper molar, the first cross-ridge consists usually of the innermost only of the original three tubercles, with sometimes a minute remnant of the corresponding outermost one, but the middle one is lost; the second cross-ridge is fully developed, while the third is much less so, with the middle tubercle large but the lateral ones barely indicated. The third upper molar is the smallest, and essentially like the second, with the elements even more reduced. In the lower jaw the first molar is the largest, consisting of three cross-ridges each of a pair of cusps, connected by a narrow isthmus, while the two other molars consist of but two cross-ridges each, of similar structure. The two anterior molars have in addition a small supplementary tubercle in the midline of their posterior border, but there is no trace of outer cingulum cusps.

In external characters there is considerable variation. The hind feet are long and slender, as typical of ground-living mammals, the five toes all with claws, but many species are partly arboreal in habits or rock-living, and have the plantar tubercles prominent. The tail in the more strictly ground-living forms is shorter than the head and body, or of about the same length, but in the climbing species it is considerably longer in proportion, while the ears vary in the same way, slightly shorter in the former and longer in the latter. Partly

hispid pelage develops in some species, varying from stiff guard hairs to an abundance of grooved and flattened spine-like hairs. Spininess seems to be correlated partly with warm climate, and may be characteristic of the summer coat but not of the winter pelage. Again spininess or a hispid condition is often associated with rock-living.

About a dozen species of this genus occur in China, most of which are widely distributed and show a certain amount of geographic variation as sub-specific forms. While most are wood or field rats, seldom frequenting human dwellings, a few, particularly *R. flavipectus* and the eastern representative of the Norway Rat, *R. norvegicus socer*, readily take advantage of the favorable opportunity for food and shelter in houses and temples, and become "house rats" parasitic on man. These two species seem to have become so thoroughly entrenched in the larger seaports that their European relatives, *R. rattus* and *R. norvegicus*, have apparently found difficulty in establishing themselves when introduced by shipping, for they must either come into vigorous competition with the native rats already on the ground, or through close affinity may interbreed with these and so become absorbed into the local rat population. The house rats assume an importance from a medical point of view, for the fleas parasitic on them may often transmit plague or other disease of which the rat acts as a carrier.

KEY TO THE CHINESE SPECIES OF *Rattus*

- A. Entire pelage dark slaty or blackish.
 - a. Tail much longer than head and body, hind foot about 37 mm. *R. rattus rattus*
 - b. Tail equaling or but slightly exceeding head and body length, hind foot 30-33 mm. *R. flavipectus* (melanotic)
- B. Pelage mixed black and some shade of tawny or brown, belly paler, white or yellowish.
 - a. Hind foot much less than 45 mm. long, including claws.
 - a'. Hair of the belly with slaty-gray bases.
 - a''. Hair of the belly more or less tipped with ochraceous, backs of fore feet brown. *R. flavipectus*
 - 1. Color below duller. *R. flavipectus flavipectus*
 - 2. Color below brighter. *R. flavipectus yunnanensis*
 - b''. Hair of the belly tipped with whitish.
 - (a). Backs of the feet white.
 - 1. Tail obviously shorter than head and body length. *R. norvegicus socer*
 - 2. Tail equaling or but slightly exceeding the head and body length.
 - a. Larger, hind foot about 35 mm., its hairs burnished. *R. nitidus*

a'. Tail dark above and below.....	<i>R. nitidus nitidus</i>
b'. Tail pale below.....	<i>R. nitidus humiliatus</i>
b. Smaller, hind foot about 32 mm., its hairs dull whitish.....	<i>R. losea</i>
a'. Belly dull white.....	<i>R. losea exiguus</i>
b'. Belly with a buffy wash.....	<i>R. losea celsus</i>
(b). Backs of feet dusky.....	<i>R. eha ninus</i>
b'. Hair of the belly with pure white bases.	
a''. A buffy or yellowish tinge over the ventral surface.	
(a). Size larger, hind foot coarse, 33-36 mm., skull length about 40 mm.....	<i>R. rattus sladeni</i>
	<i>R. rattus hainanicus</i>
	<i>R. rattus alexandrinus</i>
(b). Smaller and slender forms, hind foot less than 32 mm., skull 39 mm. or less.	
1. Pelage markedly hispid or mixed with spines, colors bright, ochraceous or fulvous, tail bicolor, ears smaller, 18-20 mm.....	<i>R. fulvescens</i>
a. Color brighter, nearly ferruginous on sides.....	<i>R. fulvescens fulvescens</i>
b. Color duller, more ochraceous.....	<i>R. fulvescens huang</i>
2. Pelage softer, without spines in winter at least, colors dull to pale ochraceous, tail often white-tipped, ears larger, 21-24 mm.	<i>R. confucianus</i>
a. Tail longer than head and body.	
a'. Backs of feet dusky.....	<i>R. confucianus confucianus</i>
b'. Backs of feet white or buffy.	
1. Pelage soft, at least in winter, color paler.....	<i>R. confucianus sacer</i>
2. Pelage partly hispid throughout the year, color brighter.....	<i>R. confucianus lotipes</i>
b. Tail little if any longer than head and body.....	<i>R. confucianus chihliensis</i>
b''. Lower surfaces pure white to roots of hair, without buffy or yellowish tint.....	<i>R. andersoni</i>
b. Hind foot more than 45 mm., usually about 55 mm.	
a'. Dorsal coloring mixed black and tawny.....	<i>R. edwardsi</i>
a''. Back less dark, pelage harsh.....	<i>R. edwardsi edwardsi</i>
b''. Back darker, pelage soft.....	<i>R. edwardsi gigas</i>
b'. Dorsal coloring chocolate brown, minutely ticked with white.....	<i>R. bowersii</i>
a''. Color slightly darker, premaxillaries exceeding nasals in backward extent.....	<i>R. bowersii bowersii</i>
b''. Color slightly paler, premaxillaries and nasals about equal in backward extent.....	<i>R. bowersii latouchi</i>

422. *Rattus rattus sladeni* (Anderson)

SLADEN'S ROOF RAT

Mus sladeni J. Anderson, Anat. and Zool. Researches Western Yunnan, p. 305, 1879.

Rattus rattus sladeni G. M. Allen, Amer. Mus. Novitates, no. 217, p. 2, 1926. Osgood, Publ. Field Mus. Nat. Hist., zool. ser., vol. 18, p. 299, 1932.

Type specimen.—No type specimen was designated by J. Anderson, who had as the basis of his description several specimens which are now in the Indian Museum at Calcutta. According to Kloss, who has reexamined them recently, they are preserved in alcohol. The series was obtained on the Burmese border of Yunnan, the only specific locality mentioned in the original description being Ponsee in the Kakhyen Hills, 3,500 feet altitude.

Description.—A small area on the sides of the muzzle below the vibrissæ distinctly gray; the sides of the face below the eyes ochraceous; rest of the upper parts of the body the usual "rat color," a rather bright tawny evenly mixed in the mid-dorsal region with long black hairs, which are fewer on the flanks, so that the flanks are clearer tawny or pale ochraceous. Backs of the fore and hind feet thinly clad with minute stiff whitish hairs, the hind feet sometimes with an ill-defined central area of dark brownish on the metatarsals. The absence of a dark central area on the backs of the fore feet is useful as a distinguishing character when comparing with *R. flavipectus*. Ears large, thinly covered with minute dark-brownish hairs. Tail dark all around, its scaly covering showing through the short dark-brown hairs which are about the length of two scale-rows and frequently arranged in groups of three to a scale. Ventral surface from the chin to the anus and the under sides of the limbs to the wrist and the ankle, white to the roots of the hairs, often with a very faint pale-buff tint. Frequently there are dark-gray hairs in the middle line of the chest, which form a narrow spot of varying extent. The line of demarcation between the dorsal coloring and the white of the belly is sharply marked. The mammæ in specimens examined are twelve in number, three pairs pectoral and three inguinal.

The skull has the same general features as that of *R. rattus rattus*, with the temporal ridges bowing evenly outward behind the orbits and closing in again to the corner of the interparietal. There is scarcely any evident prolongation of the ridge into a blunt postorbital process at the front corner of the parietal, such as is so marked in adult skulls of the Hainan race. The outline of the interpterygoid fossa at the border of the palate is usually an even arch.

Measurements.—The tail is longer than head and body, averaging about 114 per cent of that measurement, or about 53 per cent of the total length, not so long as in some of the Indian races. The following field measurements of adults are available:

No.	Head and body	Tail	Hind foot	Ear	Locality
43357	165	193	33.0	24.0	Yunnan
43358	170	205	33.5	23.0	Yunnan
43359	165	198	35.0	23.5	Yunnan
43360	175	—	36.0	25.0	Yunnan
43362	150	164	32.0	20.0	Yunnan
43441	160	174	32.0	25.0	Yunnan
43352	175	193	33.0	23.0	Yunnan
43355	170	208	34.5	24.0	Yunnan
43372	170	185	35.0	25.0	Yunnan
43373	185	205	37.0	24.0	Yunnan
43427	160	187	34.0	24.0	Yunnan

CRANIAL MEASUREMENTS OF CHINESE RACES OF *RATTUS RATTUS*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across post-temporal angles	Upper cheek teeth	Lower cheek teeth	Locality
<i>R. rattus sladeni</i>									
43352	42.2	38.0	24.0	21.2	16.3	12.0	7.9	7.7	Yunnan
43354	41.2	36.0	22.4	20.5	15.3	11.6	7.8	7.5	Yunnan
43355	41.0	36.4	22.5	20.0	16.0	11.8	7.5	7.7	Yunnan
43372	40.5	36.5	22.4	20.3	16.0	12.0	7.5	7.3	Yunnan
43373	44.8	40.0	24.4	22.5	16.5	11.8	7.5	7.6	Yunnan
43421	41.6	37.0	22.3	20.2	15.2	12.2	7.5	7.5	Yunnan
43427	40.3	—	22.1	19.4	16.0	12.4	7.3	7.1	Yunnan
43429	40.8	36.0	22.6	19.1	15.8	13.0	7.5	7.6	Yunnan
43430	39.5	35.0	22.0	19.3	15.7	13.0	7.6	7.7	Yunnan
43412	39.0	34.2	21.4	19.1	15.0	—	7.4	7.8	Yunnan
<i>R. rattus hainanicus</i>									
58969	46.6	41.4	25.9	21.2	16.8	—	8.2	7.0	Hainan
59029	41.8	36.3	22.3	20.1	15.4	—	7.7	7.5	Hainan
59097	36.2	31.4	19.7	17.5	14.5	—	7.0	6.8	Hainan
59178	43.7	38.0	23.7	20.7	16.2	—	7.7	7.7	Hainan
59222	40.0	35.4	22.1	19.0	15.6	—	7.5	7.6	Hainan
59223	44.0	39.0	23.8	20.7	16.2	—	7.8	7.8	Hainan

Occurrence and Habits:—Kloss, who restudied Anderson's types in the Indian Museum, regards them as representatives of a valid race of the long-tailed, large-eared Roof Rat, so widely distributed in the warmer parts of Europe, northern Africa, and Asia. Its distinctive characters, it must be admitted, are not very striking, but in view of the tendency shown by this animal to develop local races in India, as worked out by Hinton, it may for the present stand as a subspecies of *R. rattus* until more nearly final appraisal of the recognizable forms is made. The usually pure-white belly with a tendency to develop a median gray streak is rather striking, for the urban forms of this

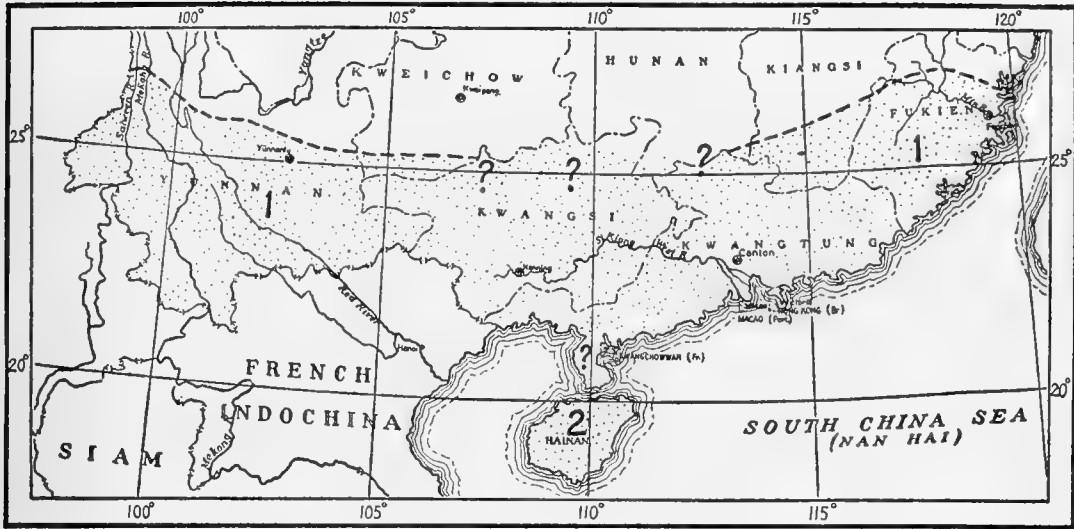


FIG. 48. Distribution Map.

*Rattus*1. *R. rattus sladeni*2. *R. rattus hainanicus*

species, as Hinton has remarked, tend to have gray-based fur on the ventral parts of the body.

This race of Roof Rat seems to be the wild form of southern China, uncommon apparently in the eastern provinces whence I have seen but three specimens, all from Yenping and Yuki, Fukien. In southwestern Yunnan Dr. R. C. Andrews obtained a series from localities near where Anderson procured the original specimens, close to the Burma border. From the Namting River eastward to Talifu in southern Yunnan, and as far north as Peitai, forty miles south of Chungtien, he found it in small numbers, apparently living like a wild native species, although no special notes are available. Of those mentioned from Fukien, two were noted as taken in swordgrass by a river bank. Probably in extreme southern China it is found along the length of the border, for Osgood has recorded it from the highlands of Tongking in the adjacent parts of French Indo-China.

Seven embryos were found in one taken September 29, 1916, at Talifu.

The name *R. r. sladeni* was given in honor of Lieutenant-Colonel Edward B. Sladen, in command of the First Yunnan Expedition of 1867 and at that time British Political Resident at the Court of Mandalay.

Specimens examined.—The following thirty-six:

Yunnan: Namting River, Burma border, 18; Talifu, 1; Changlung, Salween River, 3; Hsiaotien, Mekong River, 4; Mengpolo, Salween drainage, 1; Shangkwang, Tali Lake, 2; Watien, 1; Yunnanyi, 1; Homushu Pass, 8,000 feet, 1; Peitai, forty miles south of Chungtien, 1.

Fukien: Yenping, 1; Yuki, 2.

423. *Rattus rattus hainanicus* G. M. Allen

HAINAN ROOF RAT

Rattus rattus hainanicus G. M. Allen, Amer. Mus. Novitates, no. 217, p. 3, 1926.

Type specimen.—An adult female, skin and skull, No. 59223, American Museum of Natural History, from Namfong, island of Hainan, China. Collected February 15, 1923, by Clifford H. Pope, Central Asiatic Expeditions.

Description.—A rat similar to *R. r. sladeni*, but with a tail apparently longer in proportion, about 115-134 (average about 120) per cent of the head and body length instead of about 114 per cent; skull heavier, with overhanging postorbital angle.

The dorsal surfaces of the head and body are much as in *R. r. sladeni* of Yunnan, but duller, nearer "yellow ocher" than the "ochraceous buff" of the latter, considerably darkened in the middle area of the back by long black hairs which may become somewhat hispid over the rump. Cheeks and sides of the body grayer, due to a reduction in the number of black hairs and the showing through of the gray bases of the pelage. Backs of the feet clothed with short whitish hairs. Tail dark all around, though occasionally (in two out of ten) with a short white tip. Under parts buffy white to the bases of the hairs, with occasionally a small gray spot in the center of the chest. Mammary twelve.

The skulls of the Hainan series of this rat show a very strong development of the supraorbital ridges which are broad and overhanging, with a prominent flattened angle just back of the orbit at the junction of the outer corners of frontal and parietal bones. The incisive foramina are wider and more bowed outward than in Yunnan skulls of *R. r. sladeni*, and the audital bullæ are slightly larger. In other respects the skulls of the two are practically alike.

Measurements.—The field measurements of the series collected by Mr. Clifford H. Pope show a relatively longer tail than in *R. r. sladeni*, but it remains to be seen whether or not this may prove to be due to differences in the manner of making this measurement. Seven adults gave the following dimensions:

No.	Head and body	Tail	Hind foot	Ear	Locality
59029	170	180	32	22	Hainan
59097	128	172	31	20	Hainan
59178	165	210	36	22	Hainan
59222	160	185	32	23	Hainan
59223	180	222	31	24	Hainan
59244	170	205	32	25	Hainan
59271	163	206	31	23	Hainan

Cranial measurements are given in the table under *R. r. sladeni*.

Occurrence and Habits.—This is but a slightly characterized race, the precise value of which must await a further working out of the races of this rat in the East. The heavy skulls with more prominent cranial ridges and well-developed postorbital angles seem to be distinguishable from those of the mainland series. It is quite possible, however, that when more material is available from eastern Indo-China, the Hainan rat will be found to be the same. Mr. Clifford H. Pope obtained a series of ten at Nodda and Namfong, Hainan, where it appears to be uncommon, for no more were secured in spite of much trapping.

Specimens examined.—The following ten:

Hainan: Nodda, 5; Namfong, 5.

424. *Rattus rattus rattus* (Linnæus)

EUROPEAN BLACK RAT

Mus rattus Linnæus, Syst. Nat., ed. 10, vol. 1, p. 61, 1758.

Mus (Epimys) rattus Jacobi, Abh. u. Ber. Mus. f. Tier- u. Völkerk., Dresden, vol. 16, no. 1, p. 14, 1922.

Rattus rattus rattus A. B. Howell, Proc. U. S. Nat. Mus., vol. 75, art. 1, p. 59, 1929.

Type specimen.—No specimen that could be regarded as the "type" is known to exist. Linnæus's name is presumed to be based on specimens from near Upsala, Sweden.

Description.—This is the melanistic race of the roof rat supposed to be native to western Europe. In color it is blackish above, sometimes with a brownish tint, and more plumbeous below. Occasional individuals occur that are affected with albinism, causing irregular white areas along the mid-ventral line, on the forehead, or tail tip, or elsewhere.

The skull in all the races of *Rattus rattus* is essentially similar, being rather slender with long slender nasal bones that taper slightly posteriorly, and end 1 or 2 mm. in front of the tips of the ascending processes of the premaxillaries. Just behind these latter begin the well-marked raised ridges which pass along the edge of the orbits and bow outward, reaching their widest point above the posterior roots of the squamosal processes, then curve in again, ending at the outer corners of the interparietal. The latter bone is large, with a brace-shaped anterior and posterior border, its greatest length in the median line equaling half its width. The incisive foramina are long and narrow, penetrating quite to the level of the first molar. The tooth pattern is essentially like that of the *R. norvegicus* group except that (as pointed out by G. S. Miller, Jr., 1912) the outer tubercle of the first transverse row in m^1 is distinctly separated off by a shallow valley on the anterior slope of the tooth, whereas this is lacking in the latter species.

Measurements.—No measurements of Chinese specimens of this race are

available. Full-grown specimens from Jugoslavia measure: head and body, 155, 155 mm.; tail, 190, 190; hind foot, 34, 30; ear, 18, 23. Larger size may be attained, up to 209 for head-and-body length, with a tail of 233, hind foot, 40, and ear 25.5 (Miller). The tail is always considerably longer than head and body and the ears are longer in proportion than in the Norway Rat.

The skull of an old male from Syria measures: greatest length, 43.7 mm.; basal length, 39.2; palatal length, 23.4; zygomatic width, 20.9; mastoid width, 17.4; width across molars, 9.1; upper cheek teeth, 6.5; lower cheek teeth, 6.4. Miller gives as a point of distinction from the European Norway Rat, that the width across the cranial ridges exceeds the outer border of the parietal. In old animals the posterior boundary of the interparietal develops as a low sharp ridge, below which the posterior aspect of the skull drops almost perpendicularly.

Occurrence and Habits:—The European Black Rat has been carried by ships to many parts of the world, and there is thus no reason why it should not often have reached the seaport cities of eastern China. Actual records, however, seem to be few, partly, no doubt, because most mammal collectors believe it to be hardly worth while to preserve specimens, and partly, perhaps, because introduced rats may mingle freely with their relatives of native races, and so become absorbed into the rat population already on the ground. A. B. Howell (1929), in recording a single specimen from Futsing, Fukien, writes that it is immature, and may be a melanistic individual of some native form. The American Museum Asiatic Expeditions secured what appears to be this animal at Kuliang, Fukien, a single skin without skull. The only other record is that of Jacobi (1922), who mentions a "*Mus (Epimys) rattus*" from Omei Shan, Szechwan, but it seems very doubtful to me if this should be considered as of the present race without further consideration.

Specimens examined:—One, from Kuliang, Fukien.

425. *Rattus rattus alexandrinus* (Geoffroy)

Mus alexandrinus Geoffroy, Cat. Mamm. Mus. d'Hist. Nat. Paris, p. 192, 1802.

Type specimen:—Possibly the type specimen is in the Muséum d'Histoire Naturelle at Paris, if it could be identified. The type locality is Alexandria, Egypt.

Description:—With the large ears and the tail exceeding the head and body length, this rat is proportioned as in *R. rattus rattus*, but is non-melanistic. The upper side in specimens from the southern United States, assumed to be like the Egyptian animal, is a mixture of all-black with particolored hairs, the latter slaty at their base, with a broad tip of an ochraceous tint. The black hairs are

more numerous over the mid-dorsal area of the back, which is therefore noticeably darker than the sides of the head, neck and body, which are brighter ochraceous, slightly but evenly darkened by an admixture of black. On the fore feet the dark color of the forearm extends on to the metacarpal area as a dusky marking narrowly bordered at the sides of the hand with whitish. The backs of the hind feet range from uniformly whitish to dusky. The color of the belly varies from pure white to the roots of the hairs, faintly tinged with buffy, to a soiled white with the bases of the hairs pale gray. This seems to be a purely individual difference, but Hinton, in his review of the Indian members of this species, adduces evidence to show that, in general, urban rats have the dark bellies, while those living away from dwellings under natural conditions are usually white-bellied. Tail dark all around, blackish, thinly clothed with short black hairs, each about the length of a scale-row and a half. These hairs are so scattered that the tail-rings are clearly visible.

According to the intensity of the ochraceous element of the dorsal hairs, the general color above ranges from a buffy gray to a dull, pale grayish, mixed with black in specimens from southern United States.

The skull and teeth are essentially as in the Black Rat.

Measurements:—In general the size and proportions are as in *R. rattus rattus*, with relatively large ears and tail longer than head and body. A specimen from Georgia measured in the flesh: head and body, 175 mm.; tail, 225; hind foot, 37; ear, 24. An adult skull from Louisiana measures: greatest length, 43.6 mm.; basal length, 40.0; palatal length, 23.8; zygomatic width, 20.2; mastoid width, 17.6; width across molars, 8.6; upper cheek teeth, 6.5; lower cheek teeth, 6.8. Greater size is often attained.

Occurrence and Habits:—The status of this Mediterranean and European race of the Black Rat in China is far from clear. While no doubt it is frequently carried by vessels to the seaports of southern China, there is little evidence that it has succeeded in establishing itself well in that country, for not only is the ground already occupied by the native races, but also, for this very reason, occasional waifs would be assimilated with the related forms and hence rarely be detected. Swinhoe (1870c, p. 636), writing at a time when less attention was paid to the discrimination of local races, mentions it as present in country villages about Amoy, regarding it as "an earlier introduction" than the Norway Rat which he supposed to be the one commonly seen in the towns. The only definite recent record, however, is that by A. B. Howell (1929, p. 59) of one in the U. S. National Museum, captured one hundred and fifty miles up the Min River, Fukien. The specimen, he writes, "is indistinguishable from selected European skins and this, together with the fact that it was taken by a river whence [whither] it could have been transported by boat, obliges me to identify

it as of this race. The tail is 142 per cent of the head and body length and the total length of the skull is 40.5 mm. The length of the tail renders it unlikely that it might properly be ascribed to *sladeni*."

Through the kindness of Mr. Arthur de Carle Sowerby, the Museum of Comparative Zoölogy has received several skins of rats taken in the city of Shanghai purposely to afford a clue as to the nature of the rat population there. Of these five well-made skins, four are *R. f. flavipectus* with buffy-washed gray bellies and relatively shorter tails, while one seems quite indistinguishable from specimens of the *R. r. alexandrinus* type from the United States, agreeing in the longer tail, with coarser, more evident scales and grayish belly; there is a small white chest spot. Since the range of this rat in Europe and where introduced in North America is in the warmer portions of the temperate zone, it may be that in China it will be found to have established itself only in the ports of the southern half of the country from Shanghai southward. Even here it probably interbreeds with the related *R. f. flavipectus*, so that the colonial development of the introduced form will necessarily be difficult without frequent importations from overseas. Additional information as to the constituency of local rat populations in the seaport towns and cities is much to be desired.

Specimens examined.:—One, from Shanghai, Kiangsu (M.C.Z.).

426. *Rattus flavipectus flavipectus* (Milne-Edwards)

BUFF-BREASTED RAT

Mus flavipectus Milne-Edwards, in David, Nouv. Arch. Mus. d'Hist. Nat. Paris, vol. 7, Bull., p. 93, footnote, 1871. Milne-Edwards, Recherches pour servir à l'Hist. Nat. des Mammifères, p. 289, pl. 42, fig. 1, 1868-74.

Mus ouang-thomæ Milne-Edwards, in David, Nouv. Arch. Mus. d'Hist. Nat. Paris, vol. 7, Bull., p. 93, footnote, 1871. Milne-Edwards, Recherches pour servir à l'Hist. Nat. des Mammifères, p. 290, 1868-74. Kiangsi.

Mus rattus flavipectus Thomas, Proc. Zool. Soc. London, 1898, p. 772.

Epimys flavipectus G. M. Allen, Mem. Mus. Comp. Zool., vol. 40, p. 227, 1912.

Rattus flavipectus G. M. Allen, Amer. Mus. Novitates, no. 217, p. 6, 1926.

Type specimen.:—This species was briefly characterized on the basis of a specimen (or more?) sent by Père Armand David from Muping, Szechwan, China, to the Muséum d'Histoire Naturelle at Paris, where presumably the type still is. No specimen was mentioned by number.

Description.:—The chief characters distinguishing this rat from the closely related *R. rattus alexandrinus* are: the slightly smaller average size, the relatively shorter tail, and the slight buffy suffusion over the belly. The dorsal coloration also averages a little warmer ochraceous, but this is by no means distinctive. As first mentioned by Bonhote (1906), a very constant character is the dark central area of the back of the hand. General color above much as in *R. r. alexandrinus*, a mixture of ochraceous-tipped and black hairs, the latter more numerous over the central area of the back, giving a nearly uniform dull

ochraceous appearance. In some specimens there is a band of grayish below the ochraceous tips, which serves to pale out the general tone. Sometimes, too, the hairs of the back may be semi-spinous, and occasionally a few white hairs are mixed in. The ears are thin, nearly naked, and very scantily clothed with minute dark-brown hairs. The fore feet are whitish at the sides and on the fingers, but the central metacarpal area is dark, varying from blackish to gray-brown, with more or less of minute ochraceous hairs mixed in. The backs of the hind feet may be nearly all whitish, with a mixture of darker hairs in the central part of the metatarsals, or the entire foot may be somewhat dusky. The tail is dark all around, and so thinly haired that the scale-rows are clearly visible. The minute hairs are arranged in more or less definite groups of three to a scale, and are about the length of a scale and a half. On the chin and fore part of the throat, and at the wrists, the hair is dull white, but the rest of the ventral surface of the body and limbs has the hair gray at the base, then tipped with white and buff, giving a distinct buffy wash over all.

The skull averages smaller with smaller audital bullæ and a narrower interparietal than that of *R. r. alexandrinus*, but in other respects, as in general proportions, the outwardly bowing cranial ridges, and the details of the tooth pattern, the two are very much alike. The first upper molar consists of three transverse ridges or crests, the anteriormost of which has three tubercles, each marked off by an indentation on the anterior face, the innermost one slightly displaced backward of the two others. The second crest is the most regular, consisting of three tubercles arranged in a transverse row; the middle one of the three is the largest and is placed slightly anterior to the two others, which are of equal size. The third crest has the large middle tubercle well developed, and a small outer one, but the innermost has been lost. The second upper molar is similar to the first except that the first crest is represented only by the innermost of the three tubercles, and the third crest has its outer cusp hardly distinct from the single central one. The third upper molar is still smaller, with the lateral cusps of the middle crest more turned backward, but otherwise similar in the reduction of the first crest to an inner tubercle, and of the third crest to the median tubercle, with a very slight extension to the outer side marking a vestigial tubercle. In the lower jaw the first molar has three transverse crests, each consisting of a pair of tubercles, with a minute cingulum cusp on the outer side between the second and third crests, and a similar median one on the posterior border. The second lower molar consists of two transverse pairs of main cusps, with a trace of a minute antero-external cingulum-like cusp, and a median one at the posterior border. The last lower molar is similar but smaller, lacks the cingulum cusps, and has the two cusps of the posterior crest fused into a single median cone.

Measurements:—This rat is somewhat smaller than the larger specimens

of *R. rattus alexandrinus*, with the tail slightly longer than the head and body, or sometimes hardly exceeding that measurement, as the following dimensions taken from fresh specimens in the field indicate:

No.	Head and body	Tail	Hind foot	Ear	Locality
56769	161	167	33	20	Szechwan
59872	155	162	31	22	Szechwan
MILNE-EDWARDS (type)	200	160	31	18	Szechwan
44625	140	150	33	20	Fukien
44626	146	163	33	21	Fukien
84665	158	170	32	21	Fukien
84666	147	169	30	20	Fukien
84664	180	210	30	23	Fukien
59267	162	182	30	21	Hainan
43439	175	166	30	24	Yunnan

CRANIAL MEASUREMENTS OF *RATTUS FLAVIPECTUS*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
<i>R. flavipectus flavipectus</i>									
84664	39.3	35.8	21.5	19.9	16.1	8.0	6.5	6.3	Fukien
26774 MCZ	39.6	35.5	21.2	19.1	16.1	7.6	6.5	5.9	Fukien
27674 MCZ	37.8	34.4	20.3	17.8	15.6	7.7	6.5	6.5	Fukien
43489	41.4	37.8	22.7	20.5	16.7	8.8	7.0	7.4	Yunnan
7137 MCZ	36.7	32.6	19.8	17.6	15.3	7.5	6.6	6.2	Hupeh
56713	39.7	35.8	21.7	18.7	16.5	7.9	6.5	6.2	Szechwan
22670 MCZ	37.5	32.6	19.6	17.4	14.8	7.6	6.5	6.0	Kiangsu
22672 MCZ	36.2	31.4	19.2	17.6	15.2	7.3	6.5	5.9	Kiangsu
22673 MCZ	35.5	31.0	18.6	16.5	14.9	7.0	6.5	5.7	Kiangsu
22677 MCZ	37.4	32.1	19.8	16.9	14.7	7.5	6.3	5.8	Kiangsu
<i>R. flavipectus yunnanensis</i>									
43370	37.2	32.9	20.3	17.7	16.0	7.4	6.6	6.6	Yunnan
43435	37.3	33.2	20.5	19.0	15.6	8.2	6.8	6.6	Yunnan

Nomenclature.—The characters of proportionate as well as absolute size of the tail to head and body, as well as of the skull, seem to show that this is a distinct species from the European type of Roof Rat (*R. rattus alexandrinus*). It remains to be seen, however, whether it actually does intergrade through other eastern races in parts of India. In tooth pattern the two are identical and evidently closely related. The name *Mus flavipectus* was published by Milne-Edwards at the same time as *Mus ouang-thomæ* (named for David's faithful Chinese servant, "Yellow Tom"), and has merely paragraph priority on the same page. The latter name was given chiefly because the single specimen sent to the Paris Museum had a white cross-shaped mark on the chest, but as Mell (1922) points out, this occurs frequently in *R. flavipectus* in South China,

for among the daily quota of twenty to twenty-four rats he fed to his pet owls in Kwangtung, he found that about one in three to one in four were so affected. The type specimen of *M. ouang-thomæ* came from Kiangsi. Milne-Edwards's figure of it shows a rat that might equally well pass for *R. losea exiguus*, also common in South China, but in this the white chest spot does not seem to be present normally, so that probably Bonhote was correct in regarding it as a synonym of *M. flavipectus*.

Occurrence and Habits.—The Buff-breasted Rat is a common and characteristic species across southern China from the Yangtze basin southward, and may usually be distinguished by its size, with tail only slightly exceeding head and body, by the buffy wash over the ventral side, and by the dark metacarpal area. Wherever it is found, it takes readily to urban life and is the common house rat of South China. As mentioned under the introduced races of *R. rattus*, it is probable that the latter are less prone to colonize the eastern seaport cities because this rat already is in possession, while the new arrivals must, on account of their close relationship with it, be readily absorbed through interbreeding. Of a half-dozen rats collected for me at Shanghai by Mr. A. de C. Sowerby, all but one are clearly *R. f. flavipectus*, and of a large series trapped by Chinese students at Foochow, Fukien, and sent me by Professor Claude Kellogg, this was again the predominant species, the only other being the native race of *R. norvegicus*. Mell (1922) notes that it is the commonest house rat of the large cities of South China, and abounds along all the canals of the Canton region. He mentions blind nest-young found in that district in the months of April, June, October and late December, so that it evidently breeds freely during at least the greater part of the year. The original specimens were sent from central Szechwan (Muping), and later collectors have found the species fairly common in that province, though perhaps less so than in the lowland cities. W. R. Zappey obtained it at Ichang, western Hupeh. The American Museum Asiatic Expeditions brought back series from Chunganhsien, Futsing, Kuliang, and Yenping in eastern Fukien; Dr. Granger trapped a number about the temple at Wanhsien, eastern Szechwan; while Dr. R. C. Andrews and Edmund Heller found it at various points in northern Yunnan, up to 10,000 feet altitude on Peitai in the Chungtien district. Little information is at hand as to its presence in the extreme southern part of China, but in the low country of southwestern Yunnan it intergrades with a slightly different race, to which I have applied Anderson's name *yunnanensis*. In the extreme southeast, Mell found it abundant, as mentioned above, in the Canton area, and Mr. Clifford H. Pope brought back a few from Hainan where it seems to have been less common. They are found not only in houses and temples but in the rice fields and along the canals. A. B. Howell records specimens from some of the above localities and one from Omei Shan, Szechwan.

The occasional occurrence of individuals with a white area on the chest has already been noticed. Howell found this mark in but three of the forty-three individuals he examined, while Mell found it in a third to a fourth of those brought in about Canton. Black individuals are also occasionally taken. One of the series sent by Sowerby from Shanghai was in color quite like a Black Rat (*R. rattus rattus*), except that on the right side of the body below the median area is a spot of clear ochraceous about 20 mm. long and half as wide. This specimen might be taken for a Black Rat, but the measurements favor its being merely a black variant of the buff-breasted species, or possibly a hybrid between the two animals through an introduced example of the former. The imperfectly black pelage is noteworthy. Two other black examples are included in the fine series of over sixty *R. f. flavipectus* sent me by Professor Claude R. Kellogg from Foochow, and appear to be merely melanistic individuals of that species.

Specimens examined:—The following one hundred and thirty-six:

Fukien: Chungansien, 1; Foochow, 68 (M.C.Z.); Futsing, 7; Kuliang, 2; Yenping, 21.
 Hainan: Namfong, 2; Riudon, 1.
 Hupeh: Ichang, 3 (M.C.Z.).
 Kiangsu: Shanghai, 5 (M.C.Z.); Nanking (Univ. Mich.), 7.
 Szechwan: Wanhsien, 10.
 Yunnan: Likiang, 1; Mekong River (Hsiaotien), 3; Peitai Mountain, 1; Yuankiang, 1; Yunnanyi, 3.

427. *Rattus flavipectus yunnanensis* (Anderson)

YUNNAN BUFF-BREASTED RAT

Mus yunnanensis J. Anderson, Anat. and Zool. Researches Western Yunnan, p. 306, 1879.

Rattus flavipectus yunnanensis G. M. Allen, Amer. Mus. Novitates, no. 217, p. 7, 1926.

Type specimens:—Anderson, in his original description, mentions no "type specimen" but remarks merely that this is the common house rat at "Ponsee, Hotha and Teng-yue-chow," the two first localities on the Burma border of extreme western Yunnan, the last a short distance farther east in Yunnan. The two original specimens of which the measurements are given are to be considered the cotypes and are perhaps still in the Indian Museum at Calcutta.

Description:—This is a somewhat more brightly colored race than the typical *R. f. flavipectus*, with ochraceous tints predominating, and the black hairs of the central part of the back slightly less abundant or at least less concentrated. On the under parts the belly is nearly white with the yellowish wash usually more restricted to the throat and middle area of the belly and chest, the latter being even of a decided rusty tint and the throat crossed by a collar of the same.

The skull is not different from that of the typical race.

Measurements:—The largest specimens in a series of old and young secured by Dr. Roy C. Andrews and Edmund Heller were measured by the latter as follows:

No.	Head and body	Tail	Hind foot	Ear	Locality
43425	150.0	173.0	32	24	Yunnan
43428	158.0	160.0	33	22	Yunnan
43434	155.0	170.0	31	21	Yunnan
43361	150.0	153.0	31	21	Yunnan
43363	170.0	—	32	23	Yunnan
43364	155.0	138.0	32	20	Yunnan
43369	155.0	180.0	33	23	Yunnan
84945	153.0	155.0	29	19	Yunnan
84946	155.0	162.0	29	20	Yunnan
ANDERSON (cotype)	144.5	143.5	30	19	Yunnan

The general size is practically as in the typical race, with apparently a very little longer tail on the average. At least there are fewer specimens in which the tail is not decidedly more than the head and body length.

Cranial measurements are given in the table under the typical race.

Occurrence and Habits:—The rat described by J. Anderson (1879) from extreme southwestern Yunnan as "*Mus yunnanensis*" seems to be only a very slightly differentiated race of the *R. f. flavipectus* type of the Chinese highlands that has become rather more brightly colored in the subtropics of northern Burma and southwestern Yunnan. As Osgood (1932) says, they are really but intermediates between the former and a race from northern India described by Hinton as *Rattus rattus tistae*, probably better considered a race of *R. flavipectus* or, as Osgood suggests, united with *R. f. yunnanensis*.

Specimens that are referable to this race were secured at various localities in the far southwest of Yunnan where many of them were trapped in temples and houses. The localities represented are: Namting River on the Burma border, Changlung on the Salween River, and Yuankiang on the Red River. Three nest-young were collected at the last locality on November 18, 1926. One of these has a bar of pure white across the lower throat.

Specimens examined:—The following thirty are referred to this race:

Yunnan: Namting River, Burma border, 7; Changlung, Salween River, 10; Kaochiao, 1; Yangwupa, 3; Yuankiang, 8; Mucheng, Salween drainage, 1.

428. *Rattus nitidus nitidus* (Hodgson)

Mus nitidus Hodgson, Ann. Mag. Nat. Hist., ser. 1, vol. 15, p. 267, 1845.

Mus griseipectus Milne-Edwards, in David, Nouv. Arch. Mus. d'Hist. Nat. Paris, vol. 7, Bull., p. 93, footnote, 1871. Szechwan.

?*Mus rubricosa* Anderson, Anat. and Zool. Researches Western Yunnan, p. 306, 1879. Ponsee and Hotha, Burma border.

Epimys griseipectus G. M. Allen, Mem. Mus. Comp. Zool., vol. 40, p. 227, 1912.

Rattus nitidus Hinton, Journ. Bombay Nat. Hist. Soc., vol. 26, p. 412, 1919. Osgood, Publ. Field Mus. Nat. Hist., zool. ser., vol. 18, p. 299, 1932.

Rattus griseipectus G. M. Allen, Amer. Mus. Novitates, no. 217, p. 7, 1926.

Type specimen.—No type specimen is mentioned by Hodgson in his very brief description which was based on specimens from Nepal. One of these, however, No. 79.11.21.415, British Museum, is said by Hinton to be the type.

The cotypes of *Mus griseipectus* Milne-Edwards are mounted specimens in the Muséum d'Histoire Naturelle at Paris, where they were examined by G. S. Miller, Jr. They were collected in Szechwan by Père Armand David about 1870.

Description.—In general appearance this rat at first sight resembles the common Roof Rat, *R. r. alexandrinus*, but is easily recognized by its shorter tail, equaling or barely exceeding the head and body length, large papery ears, and long, slender hind feet, which, like the fore feet, are clothed with minute, glistening white hairs. These hairs form at the outer side of the wrist a clear white, shining spot. The muzzle is gray mixed with black, and the same tint extends about the eyes and forehead. Elsewhere, the color above is the usual rat mixture of all-black hairs and those with ochraceous tips, the former prevailing in the mid-dorsal region which is therefore darker, the latter predominating along the sides of the neck and body which are more ochraceous. There is no line of demarcation between the color of sides and belly, but the latter is whitish with a very pale buffy wash, the hairs everywhere light gray at the base. A small percentage of specimens develop a pure white median chest spot. The gray bases distinctly showing through combine with the whitish and buff of the tips to give a peculiar and characteristic greenish tint to the lower parts of the body. The tips of the hairs are also rather shining and glisten in some lights. The long slender hind feet and the short glistening white hairs of both fore and hind feet are very distinctive. Wrists and ankles white all around. Tail unicolor, dark brown above and below, its minute dark-brown hairs not obscuring the scale-rows. Ears nearly naked, their minute hairs dark brown.

The skull is characterized by having the nasals long and tapering, ending posteriorly in a median point on a level with the posterior ends of the premaxillaries, or even slightly in advance of them. The outer tubercle of the anterior cross-row of the first upper molar is much reduced and usually not marked off by a vertical furrow on the front face of the tooth. The temporal ridges go back strongly to the notch of the parietal, and thence as finer beading to the corner of the interparietal.

Measurements.—The relatively long hind foot and the practical equality between the head-and-body and the tail measurements are indicated in the following table:

No.	Head and body	Tail	Per cent of total length	Hind foot	Ear	Locality
56760	175	186	51	35 (s.u.)	24	Hunan
56759	180	206	53	35	27	Hunan
56761	155	175	53	31	22	Hunan
56762	160	175	52	35	23	Hunan
56765	170	202	54	35	27	Hunan
56775	154	155	50	36	22	Szechwan
56782	150	135	47	35	21	Szechwan
59246	153	156	50	33	22	Hainan
59247	150	155	50	34	23	Hainan
59225	148	149	50	31	23	Hainan

CRANIAL MEASUREMENTS OF *RATTUS NITIDUS* AND RACES

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Upper cheek teeth	Lower cheek teeth	Length of nasals	Locality
<i>R. nitidus nitidus</i>									
56760	43.0	37.0	23.0	19.4	16.0	6.7	6.8	16.7	Hunan
56761	40.7	35.7	22.3	19.5	16.0	7.0	7.0	16.0	Hunan
56763	39.0	33.0	20.0	18.0	15.4	7.0	6.9	14.7	Hunan
56764	39.5	34.4	21.2	18.0	16.0	7.0	7.0	16.0	Hunan
56765	42.5	37.3	23.5	19.7	16.0	7.2	7.0	16.0	Hunan
56766	41.0	36.0	22.0	18.6	15.4	6.9	6.7	15.7	Hunan
45530	41.0	35.3	21.5	—	15.0	6.6	6.6	15.8	Fukien
56775	42.0	36.5	22.2	19.5	16.5	7.0	—	16.8	Szechwan
56782	38.5	33.3	20.3	18.8	15.6	6.8	6.7	14.5	Szechwan
43444	44.3	39.0	23.7	20.5	17.2	7.0	6.8	18.0	Yunnan
59029	41.7	36.4	22.1	20.0	15.3	7.7	7.7	15.0	Hainan
59246	39.0	33.3	20.8	18.4	15.0	6.8	6.8	15.0	Hainan
59263	41.0	35.0	22.0	19.1	16.0	7.0	7.0	15.9	Hainan
98.II.I.26 BM	42.7	38.9	23.5	—	16.1	7.1	7.3	—	Fukien
<i>R. nitidus humiliatus</i>									
82.6.16.3 BM (cotype)	34.9	—	19.0	17.6	14.7	6.5	6.5	—	Hopei
<i>R. nitidus insolatus</i>									
172569 USNM (type)	41.0	—	—	19.4	—	7.0	—	15.5	Shensi

Nomenclature:—The identification of various names given by Hodgson to members of the old genus "*Mus*" based on specimens from Nepal is still obscure and must depend on a reëxamination of that author's specimens so far as they may be preserved, for the descriptions themselves contain little of diagnostic value. Osgood (1932, p. 299) has lately concluded, on the basis of specimens from Sikkim, India, that Hodgson's *Mus nitidus* is the same as

the animal later described as *Mus griseipectus* by Milne-Edwards, from an example sent from Szechwan by Père David, and that the two are in such close agreement that the recognition of the Chinese animal even as a subspecies "seems doubtful." Accepting this conclusion and Osgood's identification of two specimens from Chapa, Tongking, as probably the same, it seems doubtful, also, if *Rattus nitidus obsoletus* from the Chin Hills, Burma, is really distinct. Milne-Edwards, in describing his *Mus griseipectus*, compares it with his *M. humiliatus* described at about the same time from Peiping. Having lately been enabled to study a skin and skull in the British Museum that is one of the cotypes of the latter animal, I find that it is clearly an immature specimen of the same species, but different enough, perhaps, to merit subspecific distinction. This makes it possible to correct my earlier (1926) determination of a series of small rats from southern China, to which I supposed, on the basis of Milne-Edwards's account and figure, this name was applicable. For, as A. B. Howell (1927) correctly points out, my *Rattus humiliatus* is the same as the one to which he gives the name *R. rattus exiguus*, but which from an examination of specimens in the British Museum I now believe to be the mainland form of *R. losea* of Formosa.

It seems very probable that Anderson's *Mus rubricosa*, described from Ponsee and Hotha in the Kakhyen Hills and border of western Yunnan, is but the brown phase of this same rat, for the characters of the pelage, as set forth in his account, and the long nasals agree well with the condition in *R. nitidus*.

Occurrence and Habits.—This rat has a wide range in southeastern Asia, from Sikkim and Nepal across the entire southern half of China to the Yangtze valley, Fukien and the island of Hainan. Osgood reports it also from the high country of northern Tongking, Indo-China. Over this immense area it shows no variation in characters of color, size or proportions that may be considered of subspecific value, for those from Szechwan and the western highlands of China seem quite the same as those from the coastal provinces. It is not until northern China is reached that possible racial differences come in. An interesting color variation is shown not only by one of the cotypes in the British Museum, but also by other specimens in that collection, in which dull chestnut hairs predominate in the pelage of the back, so that the animal has a bright brown appearance, instead of the usual mixed ochraceous. A specimen showing this color was collected by David in western Fukien in 1873, and is now in the British Museum, labeled by the collector, "Mus E, adulte, à dos roux. Peut-être simple variété du Mus D des maisons de ces montes." It agrees in this type of coloring with a specimen from Nanking previously recorded as *Mus humiliatus* by Bonhote. In this color variant the black element

is lost from the pelage or much reduced, the longer hairs having chestnut to ochraceous tips. The sides of the body are ochraceous, the belly, as usual, with gray-based hairs, white-tipped.

In addition to specimens from Szechwan taken at Kiating by Zappey, at Wanhsien by Dr. Granger, and others mentioned by Osgood (1932) from Kulu, Muli, and Yatsu, it has been found common in western Yunnan, whence the American Museum Asiatic Expeditions obtained it at Likiang, Namting River, at the Burma border, localities on the Salween and the Mekong drainage up to 9,000 feet, and a single one from Litien on the Yangtze drainage at 10,000 feet. Farther north on the border of Kansu, four specimens were taken also at Machu. In southern and eastern China, Bonhote's record of one from Nanking has already been mentioned, and the Central Asiatic Expeditions secured it at Yochow, Hunan, at Yenping, Fukien, and on the island of Hainan. A. B. Howell (1929) and Mell (1922) record what is doubtless the same species from the Canton region where the latter says it is less common than *R. flavipectus*, while Shih (1930, 1930a) records it from Yao Shan in Kwangsi and Kwangtung.

In its habits this is apparently as much a wild-living country rat as a house rat, and wherever it occurs is apparently outnumbered by *R. flavipectus*, before which perhaps it gives way. Nothing distinctive has been recorded of its habits, but the glistening hair-tips of the lower surface and of the feet, together with the length of the slender hind foot, suggest a fondness for water.

Specimens examined.—The following fifty-five:

- Fukien: Chungfengling, 3 (B.M.); Foochow, 1 (B.M.); Kuatun, 2 (B.M.); Yenping, 10; western part, 1 (B.M.).
 Hainan: Namfong, 5.
 Kiangsu: Nanking, 1 (B.M.).
 Hunan: Yochow, 8.
 Szechwan: Kiating, 1 (M.C.Z.); Wanhsien, 6.
 Kansu: Machu, 4.
 Yunnan: Chungpa (Mekong River), 1; Likiang, 1; Litien, 10,000 feet, 1; Mucheng, Salween drainage, 2; Namting River, Burma border, 2; Tashuitang, 1; Yinpankai, 3; Yungchangfu, 1; Yunnanfu, 1.

429. *Rattus nitidus humiliatus* (Milne-Edwards)

- Mus humiliatus* Milne-Edwards, Recherches pour servir à l'Hist. Nat. des Mammifères, p. 137, pl. 41, fig. 1, 1868-74.
Rattus humiliatus A. B. Howell, Proc. Biol. Soc. Washington, vol. 40, p. 44, 1927. Not of G. M. Allen, Amer. Mus. Novitates, no. 217, p. 4, 1926.
Rattus humiliatus humiliatus A. B. Howell, Proc. U. S. Nat. Mus., vol. 75, art. 1, p. 59, 1929 (?in part).

Type specimens.—No type specimen is designated, but the name was based on "un nombre d'individus" sent from the vicinity of Peiping, Hopei,

China, to the Paris Museum by Père Armand David about 1868. One of these cotypes is in the British Museum, No. 82.6.16.3, and two others are mounted in the Muséum d'Histoire Naturelle at Paris (see A. B. Howell, 1929, p. 59).

Description.—This northeastern race differs from that of South China in having the tail distinctly bicolor, paler below than above. A cotype which I have examined in the British Museum has the body above chestnut instead of the usual mixture of black and ochraceous, and the same is true of a specimen in the same collection from Nanking, but this perhaps represents a color phase, due to the failure of the black pigment to develop. The feet are, as usual, glistening white, with a distinct shining spot at the wrist. Milne-Edwards describes the color as brown mixed with red, the hairs slaty at base, and the lower side, including the lips and throat, soiled grayish.

The skull is like that of the typical race.

Measurements.—No measurements of fresh specimens are available.

The cranial dimensions are apparently not different from those of South China specimens; see table under *R. n. nitidus* for those of the specimen above mentioned.

Occurrence and Habits.—Although Milne-Edwards received a number of specimens of this animal from Père David, collected in the vicinity of Peiping, no one, strange to say, has since taken it in that part of China, where for some reason it seems to be uncommon. The specimen in the British Museum, one of the cotypes, is immature and in the brown phase, as is also the one recorded by Bonhote from Nanking, but whether this coloring is typical of the northeastern race, or whether by chance both represent an abnormal loss of the black element in the coat is not yet clear. A similar condition is shown by a skin from western Fukien. Possibly it is a result of fading out in alcohol in which the specimens may have first been preserved. The bicolor tail seems to be otherwise the most striking color character. The range of this subspecies is presumed to be from the Yangtze basin northeastward to Manchuria, where it is represented by the subspecies *R. n. sowerbyi* of Howell, who states that this is a darker form with rich coloring and sooty face. The same author records a specimen in the U. S. National Museum from Chinkiang, Kiangsu.

Specimens examined.—The following is referred to this race:
Hopei: near Peiping, 1, a cotype (B.M.).

430. *Rattus nitidus insolatus* A. B. Howell

Rattus humilatus insolatus A. B. Howell, Proc. Biol. Soc. Washington, vol. 40, p. 44, 1927.

Type specimen.—An adult female, skin and skull, No. 172569, U. S.

National Museum, from twelve miles south of Yenanku, Shensi, China, 4,000 feet altitude. Collected January 12, 1909, by Arthur de Carle Sowerby.

Description.—A very pale race, typical of the semiarid country of northern China. The type is described as having the ground color of the back nearly "pinkish buff" (Ridgway, 1912), the guard hairs very little darker, and totally without black. The under parts are pale buffy, the bases of the hairs not showing plumbeous. Feet pale, almost white. The tail is bicolor, unusually well covered with short bristly hairs so as nearly to obscure the scaling; dark brown on the upper side, whitish below.

The skull is said to be much as in the typical race, but "apparently the nasals are relatively longer, the molariform teeth considerably heavier."

Measurements.—The type measured: head and body, 165 mm.; tail, 163; hind foot, 34; ear, 21. These dimensions are not larger than in the typical *R. nitidus nitidus*, and, as in the latter, the tail is about as long as the head and body.

For cranial dimensions of the type, see table under *R. n. nitidus*.

Occurrence and Habits.—Hitherto this pallid race has been known only from the original series recorded by its describer, namely, an adult and two immatures from the type locality, Yenanku, and a fourth immature specimen from Yulinfu, Shensi. Nothing is known of its habits. Intergradation with the typical race is to be expected along the southern Kansu border and the Tsingling Range.

Specimens examined.—One, the type.

431. *Rattus losea exiguus* A. B. Howell

Rattus rattus exiguus A. B. Howell, Proc. Biol. Soc. Washington, vol. 40, p. 43, 1927; Proc. U. S. Nat. Mus., vol. 75, art. 1, p. 59, 1929.

Mus losea Swinhoe, Proc. Zool. Soc. London, 1870, p. 637 (in part).

Rattus humiliatus G. M. Allen, Amer. Mus. Novitates, no. 217, p. 4, 1926 (not of Milne-Edwards).

Rattus humiliatus exiguus Osgood, Publ. Field Mus. Nat. Hist., zool. ser., vol. 18, p. 302, 1932.

Type specimen.—An adult female, skin and skull, No. 238185, U. S. National Museum, from seventy miles southwest of Yenpingfu, Fukien, China, 500 feet altitude. Collected December 1, 1921, by Arthur de Carle Sowerby.

Description.—A small rat, at first sight much like *R. norvegicus*, the Norway Rat of Europe, but always distinguishable by its much more slender and shorter feet, by the slightly longer tail, very slightly exceeding the length of head and body, and by the small skull with its outwardly bowed supraorbital ridges and short nasals which are exceeded by the posterior extension of the premaxillaries.

Upper lips and sides of the jaws, and the backs of the fore and hind feet, white; the rest of the dorsal side of the body the usual "rat" color, a mixture of all-black hairs with others gray at the base and tipped with ochraceous. In some specimens the ochraceous is paler, producing a buffy-gray tint along the cheeks and sides, in others the ochraceous is stronger and the animal is of a brighter tone with in either case more or less of the black hairs intermixed, so that the entire median area from nose to tail is much darker than the flanks, or the black may be slightly reduced and more evenly distributed so that the back is not very much darker than the sides. The tail is thinly haired so that the tail-rings are not obscured, and is dark brown above, and perceptibly paler below. Ears medium in size, thin and nearly naked, with microscopic ochraceous or dusky hairs on the exposed portions. The transition from the coloring of the sides of the body to the soiled whitish of the belly is gradual without sharp line of demarcation.

The skull resembles that of *R. rattus alexandrinus* but is uniformly smaller. A strong supraorbital ridge extends on each side from the front of the orbit outward to the outer corner of the parietal and thence backward in a slightly convex course to near the outer corner of the interparietal. The posterior part of the ridge from the notch on the outer side of the parietal back is much less heavy, a mere raised line instead of a strong bead. The width of the interparietal about equals the distance from its outer tip to the outer front end of the parietal. The proximal ends of the nasals meet in a somewhat tapered point a millimeter or so in advance of the proximal ends of the premaxillaries, instead of on the same level with them. The posterior edge of the palate has a small median projection instead of being evenly arched as in *R. rattus*. The molar teeth are much as in the latter, but the cusps are all well marked off by constricting valleys, with the innermost one of the first transverse series in m^1 very slightly displaced backward. In the second molar the outer cusp of each of the two transverse rows is evident, that of the posterior row turned well forward and sharply marked off. This clear definition of the cusps, though they are not essentially different from those of the related *R. rattus*, nevertheless gives a rather characteristic general impression.

The incisive foramina are long and narrow, parallel-sided, equaling the alveolar extent of the tooth row, and ending at about the level of the second transverse crest of the first molar.

Measurements:—The tail slightly exceeds the combined length of head and body, while the foot is small, hardly exceeding 32 mm. in length with claws. The following measurements are selected from a large series made in the field by the collectors. In eighteen specimens from Hainan the tail averages 52 per cent of total length.

THE TYPICAL RODENTS

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No.	Head and body	Tail	Hind foot	Ear	Locality
60320	141	145	30	18.0	Fukien
84676	148	141	29	19.5	Fukien
84682	153	141	27	18.5	Fukien
84689	140	141	29	19.0	Fukien
84690	145	145	29	16.0	Fukien
59009	150	165	30	19.0	Hainan
59038	145	161	31	19.0	Hainan
59060	165	176	32	21.0	Hainan
59087	163	154	28	21.0	Hainan
59172	150	175	31	18.0	Hainan

CRANIAL MEASUREMENTS OF *RATTUS LOSEA* RACES

No.	Greatest length	Basal length	Palatal length	Zygomatic width	Mastoid width	Upper cheek teeth	Lower cheek teeth	Locality
<i>R. losea exiguus</i>								
44627	35.5	32.0	20.0	18.0	14.0	6.5	6.4	Fukien
44741	35.3	31.5	19.8	17.0	14.0	6.6	6.4	Fukien
45531	37.5	34.2	21.2	18.0	14.3	7.0	7.0	Fukien
45536	33.5	30.0	18.4	16.5	13.5	6.7	6.0	Fukien
45539	36.0	31.7	20.0	16.8	14.0	6.7	7.0	Fukien
45546	38.5	35.5	22.0	19.0	15.0	6.5	6.5	Fukien
45547	35.2	30.7	19.3	17.3	13.7	6.6	6.3	Fukien
59172	38.1	34.0	21.2	18.6	15.0	6.5	6.3	Hainan
59191	40.0	36.5	23.0	19.7	15.0	7.0	6.6	Hainan
59242	39.0	35.0	21.2	18.4	15.0	7.4	7.0	Hainan
<i>R. losea celsus</i>								
43388	36.5	32.5	20.2	18.0	14.0	7.4	7.0	Yunnan
43389	36.0	31.7	19.7	18.0	14.5	7.0	7.0	Yunnan
43390	36.6	—	20.1	18.3	15.0	7.5	7.4	Yunnan
43393 (type)	40.5	35.3	22.0	19.5	15.2	7.6	7.5	Yunnan
43394	37.0	32.8	20.5	18.5	14.4	7.4	7.6	Yunnan
43399	40.2	34.5	21.7	19.8	15.0	7.5	7.2	Yunnan
43400	40.0	34.7	21.8	19.0	15.0	7.0	7.0	Yunnan
43414	35.0	29.8	18.5	17.3	14.0	7.5	7.4	Yunnan
43415	36.0	31.8	19.3	18.0	14.3	7.0	7.0	Yunnan
43442	38.8	35.0	21.0	19.0	15.0	7.0	7.0	Yunnan

Nomenclature.—The rat that Swinhoe described from Tamsuy, Formosa, as *Mus losea* has been more or less of a puzzle for many years. Having recently, however, had the opportunity of examining a series of ten specimens so labeled in the British Museum, including the one selected as a "type" probably by Thomas, it appears that this is really only a dark insular representative of the common small rat of South China which I had previously supposed from Milne-Edwards's figure and description to be his *M. humiliatus*, and which

A. B. Howell, correcting this error, later named *R. rattus exiguus*. It is a species quite distinct from *R. rattus*, however, though with a similar superficial appearance, yet the subspecific designation will probably hold for the race of the mainland of southern China and Hainan. One of the British Museum specimens labeled *R. losea* is from Amoy and was collected by Swinhoe himself. It may have furnished the evidence on which he included the species in his list of Chinese mammals. Two of those from Formosa are young and in poor condition and perhaps are really young of *R. flavipectus*. It is by no means certain that Milne-Edwards's *Mus ouang-thomæ* from Kiangsi is not the mainland race of *M. losea*, for his figure, said to be of natural size, represents a small animal of practically the same size and color as an immature *R. l. exiguus*, with a hind foot measuring only 21 mm. in total length. Nevertheless, as mentioned under *R. flavipectus*, the likelihood is that the name is a synonym of this last, for the white chest mark mentioned as the chief distinctive character is of frequent occurrence in that species. The Japanese representative of *R. losea* is probably *R. tanezumi*, as Bonhote (1906) has pointed out.

Occurrence and Habits.—This mainland form of *Rattus losea* is noticeably less dark in color of the back, and has whitish instead of dark fore and hind feet. Its range in South China seems to parallel rather closely that of *R. flavipectus* from which, however, it is readily distinguished by the characters of size and details of the teeth already given, and by the pale hands. It is abundant in the highlands of northwestern Fukien, southward through that province to the island of Hainan, where Mr. Clifford H. Pope obtained a large



FIG. 49. Distribution Map.

Rattus

1. *R. losea losea*

2. *R. losea exiguus*

3. *R. losea celsus*

series at Nodoa and Namfong, where it apparently outnumbered all other species of rats. In Fukien the American Museum Asiatic Expeditions secured a large series at Yenping, the type locality, and others at Futsing. A. B. Howell records specimens from Foochow and Kulingsu Island as in the U. S. National Museum. Swinhoe (1870) long ago included under *Mus losea* specimens from Amoy, one of which is still in the British Museum. Presumably its range is more or less continuous at lower levels across southern China until in western Yunnan it merges into the race *R. l. celsus*. Osgood records it from the coast of Annam, Indo-China.

Mr. Clifford H. Pope writes: "This is *the* common rat about Nodoa, Hainan, . . . we found it in numbers in the high grass and bushes bordering the rice fields. We would get a dozen or more of these to one of any other kind in the open country about Nodoa, but in the jungles it was much less plentiful. Thirty traps would yield over night eight or nine of these rats." Mell (1922) notes that this is the common field and house rat in hilly mountainous districts up to 800 meters in the country inland from Canton, Kwangtung.

Specimens examined:—The following three hundred and thirty-eight:

Fukien: Futsing, 41; Yenping, 41; Chungfengling, 3 (B.M.); Amoy, 1 (B.M.); Foochow, 1 (B.M.); Chunganhsien, 1.

Hainan: Namfong, 63; Nodoa, 187.

432. *Rattus losea celsus* G. M. Allen

Rattus humiliatus celsus G. M. Allen, Amer. Mus. Novitates, no. 217, p. 5, 1926.

Type specimen:—An adult female, skin and skull, No. 43393, American Museum of Natural History, from Taku Ferry, west bank of the Yangtze River, Yunnan, China, 6,000 feet altitude. Collected November 20, 1916, by Dr. Roy C. Andrews and Edmund Heller.

Description:—In general appearance this highland race is similar to *R. losea exiguus* of the southeastern coast of China, but is longer-haired, and the buffy or cinnamon tone is lighter, the belly buffy instead of white. The general color of the type is nearly "light ochraceous buff" sparsely lined with black, the sides with less black and grading into the buffy whitish of the belly. Feet white. Tail dark brown above, but distinctly paler below. Mammæ: 3—3=12.

The skull differs from that of specimens from the eastern part of China in having slightly longer nasals, averaging about 15 mm. against 13. In other respects they seem quite alike.

Measurements:—The proportions of this race are as in the coastal subspecies, with the tail about 51 per cent of the total length. The following are the field measurements of the largest of a series from Yunnan:

No.	Head and body	Tail	Hind foot	Ear	Locality
43388	145	148	31.5	20	Yunnan
43390	140	155	32.0	21	Yunnan
43391	145	165	33.0	22	Yunnan
43399	160	178	31.5	22	Yunnan
43400	160	175	31.5	22	Yunnan
43411	165	172	34.0	22	Yunnan
43415	140	135	30.0	22	Yunnan
43442	162	163	33.0	25	Yunnan

For cranial measurements, see table under *R. losea exiguus*.

Occurrence and Habits.—The longer pelage with its grayer tone and the slightly more buffy coloring of the belly mark this slightly differentiated race of southwestern China. Osgood (1932) also calls attention to the heavier cheek teeth as compared with Hainan specimens. It is apparently not very common in western Yunnan, for the American Museum Asiatic Expeditions secured only twenty-two in the course of their field work. These are mostly from Taku Ferry on the west bank of the Yangtze, 6,000 feet altitude, with one each from Yunnanyi, 6,500 feet, and from forty miles south of Chungtien, 8,000 feet, and three each from Hapa, twenty miles north of Taku, and from Peitai Mountain, the localities at 10,000 feet altitude. Osgood records it from Baurong and Muli, Szechwan, five specimens in all, secured by the Kelley-Roosevelts Expedition, again indicating that in general it is uncommon in the area covered by these collectors.

Nothing is recorded of its habits.

Specimens examined.—The following twenty-two:

Yunnan: Hapa, twenty miles north of Taku, 3; Taku Ferry, 14; Peitai, forty miles south of Chungtien, 1; Peitai Mountain, 3; Yunnanyi, 1.

433. *Rattus norvegicus socer* (Miller)

Epimys norvegicus socer Miller, Proc. Biol. Soc. Washington, vol. 27, p. 89, 1914.

Mus humiliatus Rhoads, Proc. Acad. Nat. Sci. Philadelphia, 1898, p. 121 (not of Milne-Edwards).

Mus norvegicus Lyon, Smithsonian Misc. Coll., vol. 50, p. 134, 1907.

Epimys norvegicus G. M. Allen, Mem. Mus. Comp. Zool., vol. 40, p. 227, 1912.

Rattus norvegicus socer A. B. Howell, Proc. U. S. Nat. Mus., vol. 75, art. 1, p. 61, 1929.

?*Mus plumbeus* Milne-Edwards, Recherches pour servir à l'Hist. Nat. des Mammifères, p. 138, 1868-74.

Type specimen.—An adult male, skin and skull, No. 144020, U. S. National Museum, from Taocheo (or Taochow), Kansu, China. Collected January 30, 1905, by W. W. Simpson.

Description.—The North China native race of Brown Rat is distinguished from the European race by its softer, less coarse pelage, the smaller feet (35-38 mm. against 40-43), the more hairy tail, and by the fact that in the skull the temporal ridges go back more nearly parallel from the postorbital angle,

so that their width apart at the interparietal is about equal to or even less than that between these angles, whereas in typical *R. norvegicus* it is usually greater. In winter pelage the general color of the back is buffy gray, lined with all-black hairs, which are most abundant in the mid-dorsal region and become less numerous on the sides where the color grades without sharp boundary into the grayish white of the lower surface. The sides of the muzzle and the forehead are nearly clear gray without the buffy tint, and on the lower side the hair is everywhere gray-based except on the chin. The tail, which is shorter than the head and body, is bicolor, blackish above and grayish buff below without sharp line of division, and the very short hairs are sufficiently abundant to partly obscure the rings of scales. The backs of both fore and hind feet are white. In summer pelage the upper parts are darker, due to the prevalence of the long black hairs, while the sides are grayer on account of the partial replacement of the buffy shades by gray.

The skull is smaller on the average than in the typical race, and may have the temporal ridges more nearly parallel, so that their width apart at the interparietal is nearly the same as, instead of greater than, the width across the postoccipital angles. These nearly straight ridges will at once distinguish the skull from that of other Chinese rats. The teeth are much as in *R. rattus*, except that the outer cusps tend to be reduced. Thus in the first upper molar the outermost cusp of the first crest is hardly demarcated at all and consists of a lateral narrowed extension of the central cusp. In the second upper molar the posterior transverse crest has the outer cusp hardly as much developed, so that with slight wear this ridge attains a nearly lozenge-shaped section. The premaxillæ slightly exceed the nasals in backward extension.

Measurements:—In the rats of this group the tail is thick and short, usually markedly less than the head and body length; the hind feet are stout and shorter than in the European race, rarely exceeding 38 mm. in adults. The ears are characteristically short, hardly reaching to the eye when laid forward, and are thicker than in *R. rattus* and its races.

No.	Head and body	Tail	Per cent of tail to length	Hind foot	Ear	Locality
43351	160	130	45	35	19	Yunnan
43418	150	131	46	35	19	Yunnan
43419	188	163	46	39	20	Yunnan
56772	150	146	49	36	19	Szechwan
56773	181	171	48	35	19	Szechwan
56777	207	164	44	38	20	Szechwan
56778	160	130	45	35	18	Szechwan

In average specimens of *R. norvegicus* from eastern United States, the feet average 40 mm. or may exceed that by a small amount.

The skull in the largest specimen examined does not exceed 47 mm. in greatest length, while in the European animal this would be but an average adult measurement. The six largest skulls among thirteen adults show the following dimensions.

CRANIAL MEASUREMENTS OF *RATTUS NORVEGICUS SOCER*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Upper cheek teeth	Lower cheek teeth	Across post-orbital angles	Across ridges at inter-parietal	Locality
43351	39.3	36.0	21.5	19.6	15.7	7.0	7.1	11.5	11.0	Yunnan
43419	42.7	38.8	23.5	19.6	16.0	7.2	7.2	11.2	11.5	Yunnan
56771	39.7	36.0	21.3	19.5	16.0	6.8	6.9	11.0	11.4	Szechwan
56773	42.2	37.3	23.0	20.0	16.5	7.2	6.8	11.4	11.5	Szechwan
56776	—	—	22.2	20.4	17.0	7.0	7.0	10.5	10.5	Szechwan
56777	47.0	43.1	25.6	(23.0)	—	8.0	7.5	11.0	—	Szechwan

The skull length of the type from Taochow, Kansu, was 45.1 mm.

Nomenclature.—Although Thomas (1912e, p. 135) expressed the belief that Milne-Edwards's *Mus plumbeus* and *M. ouang-thomæ* are both synonyms of that author's *Mus humiliatus* (now *Rattus nitidus humiliatus*), it seems to me more likely that the second is the same as *R. flavipectus* and that *M. plumbeus* is a young one of the present race. This, however, is merely conjectural, and in any case, unless the original specimens of both can be identified, the names had best be regarded as undeterminable. It further seems likely that the rat mentioned by Rhoads (1898, p. 121) from Shiaohotzu, Hopei, under the name *Mus humiliatus* is really this North China race of *R. norvegicus*. The precise status of the rats recorded by Swinhoe and others from South China as *Mus decumanus* or *M. norvegicus* is also uncertain, but some of their specimens may have been of the latter race.

Occurrence and Habits.—The large stout hind foot and the short tail betoken the ground-living habits of this rat, in contrast to the lighter build and long tail of the tree-climbing or semi-arboreal species. Miller was the first to point out that the representatives of the north temperate Brown Rat in North China are smaller-footed and paler than the European animal and worthy of subspecific distinction. The pale coloring he describes for the Kansu animal, however, is perhaps partly a winter characteristic, for the summer pelage seems to be darker so far as specimens available show. In general the range includes Hopei (whence it is recorded by A. B. Howell from Peiping and vicinity and from Tientsin and Chinwangtao), and the neighboring provinces of Shansi and Shensi, westward across Kansu (specimens recorded from Lanchow, Taochow, Archuen, and others seen from Choni). In the western highlands of China it is also found, as at Wanhsien, Kiating, and Suifu in the Yangtze valley of

Szechwan, and it was collected by the American Museum Asiatic Expeditions still farther west in Yunnan, as at Likiang (8,200 feet), Makaih sien, Yuan-kiang, and Kaochia o. From northern Szechwan the Museum of Comparative Zoölogy has a skin collected in the Min valley between Weichow and Maochow. Specimens from all these localities agree in the small foot and skull and in the general coloration and soft fur. As with its European relative, it is in part a commensal with man, infesting temples and the houses of native villages, where with plenty of food and shelter it may be abundant. Osgood (1932), for example, records a large series obtained by Stevens at Nguluko, Yunnan, just north of Likiang, the only locality at which it was collected during the journey from Burma to northern Szechwan. The precise status of the Brown Rat in southeastern China is still in need of careful study. I have examined a large series from Foochow, Fukien, kindly secured for me by Professor Claude R. Kellogg as a sample of the rat population of that city, and they prove to be *R. flavipectus* in large part, with about one-third of the *R. norvegicus* type. These latter, taken in May, are in dark summer pelage, and practically indistinguishable in color from average specimens taken in the eastern United States, presumably representing the European race. Their feet, however, are smaller, and the animals are probably native to this part of southeastern China, becoming abundant about villages and towns. There must be a certain amount of importation of foreign stock, however, in the seaport towns, but it is difficult to find many specimens that could be confidently referred to the European form. A series of these rats sent me from Shanghai by Mr. Arthur de C. Sowerby seems to represent *R. n. socer*, as indicated by the small foot, a result that at first was rather surprising, since one would expect to find the introduced race here if anywhere on the east coast. No doubt, however, new-comers would readily be absorbed in the native population or be eliminated by them in competition. In addition to the series from Foochow, I have examined a few others from Fukien, including two from Yenping, taken from a small colony in the mountains, that were "denning in the ground," for this rat is a good burrower. It is also an expert swimmer and diver, hence is likely to spread along rivers and waterways. Swinhoe (1870a, 1870c) long ago accorded this rat to Hainan and "all large towns in South China," but probably he confused more than one of the native species with this, for Mr. Clifford H. Pope in several months' intensive collecting did not meet with it in Hainan. Probably the Brown Rat, as in western Europe, finds a temperate climate more favorable than a subtropical one, and hence is less common or absent in extreme southern China. Shih (1930) has recorded it from Yao Shan, Kwangtung. Mell (1922) apparently did not identify it during his residence in the Canton region; Howell, however, records specimens from Canton and Amoy. It may eventually be that the native small-footed animal of southeastern China will prove

subspecifically different from typical *R. norvegicus socer*, with less soft and buffy winter pelage. The available material, however, is insufficient to warrant this course.

Specimens examined:—The following sixty-two:

Fukien: Yenping, 2; Foochow, 16 (M.C.Z.).

Kiangsu: Shanghai, 7 (M.C.Z.); Nanking, 2 (Univ. Mich.).

Hopei: Eastern Tombs, 2; near Peiping, 2 (M.C.Z.).

Shansi: Tatungfu, 2 (M.C.Z.); near Kweihwacheng, 1 (M.C.Z.); Taiyuanfu, 1 (M.C.Z.); Yirgo, 1 (M.C.Z.).

Shensi: Taipai Shan, 1 (M.C.Z.); forty-five miles south of Fengsiangfu, 2.

Szechwan: Wanh sien, 8; Kiating, 2 (M.C.Z.); between Weichow and Maochow, 1 (M.C.Z.).

Hupei: Ichang, 1 (M.C.Z.).

Kansu: Choni, 1 (M.C.Z.).

Yunnan: Likiang, 4; Makaihsien, 1; Yuankiang, 2; Kaochiao, 2; twenty-one miles east of Chaotungfu, 1 (B.M.).

434. *Rattus fulvescens fulvescens* (Gray)

SPINY-HAIRED RAT

Mus fulvescens Gray, Cat. Mamm. Nepal and Thibet, ed. 1, p. 18, 1846.

Leggada jerdoni Blyth, Journ. Asiatic Soc. Bengal, vol. 32, p. 350, 1863.

Epimys fulvescens Wroughton, Journ. Bombay Nat. Hist. Soc., vol. 24, p. 427, 1916.

Rattus fulvescens Wroughton, *ibid.*, p. 772. Osgood, Publ. Field Mus. Nat. Hist., zool. ser., vol. 18, p. 304, 1932.

Rattus huang vulpicolor G. M. Allen, Amer. Mus. Novitates, no. 217, p. 14, 1926. Namting River, Burma border.

Type specimen:—The type is a skin, No. 45.1.8.376, British Museum, from Nepal, collected by Hodgson. It is considerably damaged, lacking the entire head and some of the posterior portion of the body. The tail is much shriveled. The animal itself is small and evidently immature, with much of its coat gone.

Description:—A delicately formed species of medium size, with slender tail longer than head and body, the pelage bright fulvous above, sharply marked off from the pure white of the lower side; and more or less hispid.

General color above, from forehead to base of tail, a bright fox color, nearly "ochraceous-orange" of Ridgway, lined in the mid-dorsal area with black, but becoming nearly clear on the cheeks, sides of body and upper sides of fore and hind limbs. The individual hairs are slaty at the base, with bright fulvous tips, intermixed with more bristly hairs, slaty at base with black tips. The muzzle is duller, brownish. Below, from chin to vent, including the lower sides of the fore limbs to the wrists, a narrow edge of the upper lip, and the inner side of the hind legs nearly to the ankle, pure white to the roots of the hairs,

with, however, a faint buffy tinge over the chest and upper abdomen, where the hairs are very slightly hispid. The base of the tail all around is fulvous, beyond which it is sharply bicolor, dusky above quite to the tip, and clear white below to the same point. The backs of the fore and hind feet have a narrow dusky median area mixed with buffy, and passing into clear buff, then white, at the sides of the feet.

The skull of this rat is very similar to that of the *R. confucianus* group, delicate and slender, with a low brain case giving a generally flattened appearance as compared with the skull of the *R. rattus* group and *R. norvegicus*. There is a prominent raised ridge extending from the front of the orbit backward, spreading outward to follow the border of the parietal back to the step or notch in the outline of that bone, beyond which the ridge is less prominent and is continued across the corner of the parietal to the outer tip of the interparietal. The rostrum is long and slender, with the nasals slightly more overhanging the incisors than in the *R. rattus* group, and ending posteriorly in a somewhat truncate outline on the level of the tips of the premaxillaries. Incisive foramina narrow, extending back to the level of the molar row. Palate ending in an even arch, very slightly thickened in a raised transverse ridge. The molar teeth show no special peculiarities. In the first molar the outermost tubercle of the first transverse row is much reduced, scarcely more than a backwardly tapering point of the main cusp. The cusps of the second row are all well developed, but in the third row both inner and outer cusps are very small though marked off by a constriction. The second molar has the main cross-ridge (the second) trituberculate, and the posterior one, though much smaller, is also symmetrically developed with a large central and two small lateral tubercles. The last upper molar has three tubercles on the inner side of the tooth, representing the innermost cusps of the three transverse rows, but on the outer side there is but one large cusp, which represents the central one of the middle cross-row. The skull compared with that of *R. confucianus* is remarkably similar, though the audital bullæ are smaller, and the posterior part of the supraorbital ridge is usually better defined.

Measurements.:—The tail is always much longer than the head and body measurement, but the general bulk of the body is much less than in the *R. rattus* group, and the animal much more slender. The following measurements were taken from fresh specimens by the collector:

No.	Head and body	Tail	Hind foot	Ear	Locality
43297	140	203	31	20	Burma border
43298	128	185	30	19	Burma border
43299	130	185	31	19	Burma border
43300	135	193	32	20	Burma border

CRANIAL MEASUREMENTS OF *RATTUS FULVESCENS*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
<i>R. fulvescens fulvescens</i>									
43297	36.0	30.1	17.5	16.3	13.8	—	6.0	6.0	Burma border
43298	35.0	29.0	16.7	15.0	12.7	—	5.5	5.6	Burma border
43299	35.0	29.3	16.8	15.8	12.5	—	5.5	5.4	Burma border
43300	35.0	29.4	17.3	16.0	13.4	—	5.8	5.7	Burma border
43301	31.5	25.4	15.4	15.0	12.0	—	5.6	5.5	Yunnan
<i>R. fulvescens huang</i>									
44586	35.8	30.5	17.7	16.0	12.6	—	6.3	5.5	Fukien
44588	36.6	30.0	17.5	16.0	14.0	—	6.0	5.6	Fukien
45590	32.5	27.5	15.8	15.0	12.6	—	5.4	5.5	Fukien
44591	36.2	31.3	18.2	16.4	14.0	—	6.0	5.8	Fukien
44592	37.2	31.5	18.3	16.9	14.0	—	5.6	5.5	Fukien
98.11.1.16 BM (type of <i>M. huang</i>)	36.5	29.8	17.6	15.7	13.6	6.6	5.3	5.7	Fukien
98.3.7.8 BM (type of <i>M. ling</i>)	32.6	27.0	16.1	13.8	12.6	6.5	5.2	5.3	Fukien
97.9.4.4 BM	35.5	28.7	17.2	—	13.7	7.0	5.7	5.8	Fukien
98.11.1.15 BM	36.0	29.5	16.9	—	13.2	6.9	5.7	5.5	Fukien
44733	39.5	32.0	19.0	—	13.2	—	6.4	5.8	Fukien

Nomenclature.—The type specimen of *Mus fulvescens* of Hodgson in the British Museum is in such imperfect condition that its identification is a matter of difficulty, but Osgood (1932) is doubtless correct in regarding it as conspecific with the later-described *Leggada jerdoni* of Blyth. The skin still shows the semi-spinous rufous back and white belly characteristic of this group of tree-climbing rats, but although it appears somewhat darker in color than the bright ferruginous-tinted specimens from the extreme southwest of Yunnan that I described as *Rattus huang vulpicolor*, this latter is probably, as Osgood suggests, a synonym. These bright-colored rats are so similar in appearance to *R. blythi mekongis* described by Robinson and Kloss from Laos, Mekong River, that I believe this name, too, should be included as a synonym of *R. f. fulvescens*. The whole group is in need of careful revision.

Occurrence and Habits.—The type locality of this rat is Nepal, but well-made modern skins from that region are not available. Following Osgood, however, the range may be regarded as extending from that country south-eastward into Tongking and possibly northern Indo-China in general, just reaching southwestern Yunnan, where Dr. R. C. Andrews secured specimens from the Burma border on the Namting River, as well as at Hsiaokela and on the Yangpi River, 5,000 feet elevation. To the eastward it merges into the

Chinese race *R. f. huang* which proves to be at most subspecifically distinct. Of the habits almost nothing is recorded.

Specimens examined:—The following six, in addition to the type from Nepal:

Yunnan: Namting River, Burma border, 4, including the type series of *R. h. vulpicolor*; Yangpi River, 1; Hsiaokela, 1.

435. *Rattus fulvescens huang* (Bonhote)

EASTERN SPINY-HAIRED RAT

Mus huang Bonhote, Abstract Proc. Zool. Soc. London, December 5, 1905, p. 19; Proc. Zool. Soc. London, for 1905, vol. 2, p. 387, 1906.

Mus ling Bonhote, Abstract Proc. Zool. Soc. London, December 5, 1905, p. 19; Proc. Zool. Soc. London, for 1905, vol. 2, p. 388, 1906. Chungfengling, Fukien.

Epimys ling Thomas, Proc. Zool. Soc. London, 1911, p. 170.

Rattus huang Cabrera, Bol. Real Soc. Esp. Hist. Nat., Madrid, vol. 22, p. 167, 1922.

Rattus flavipilis Shih, Bull. Dept. Biol., Sun Yatsen Univ., Canton, no. 4, p. 7, 1930. To replace *R. huang*.

Rattus flavipilis minor Shih, *ibid.*, p. 7. Kutchen, Loshiang, Kwangsi.

Rattus wongi Shih, *ibid.*, no. 12, p. 6, 1931. Yao Shan, Kwangtung.

Rattus fulvescens huang Osgood, Publ. Field Mus. Nat. Hist., zool. ser., vol. 18, p. 304, 1932.

Type specimen:—An adult male, skin and skull, No. 98.11.1.16, British Museum, from Kuatun, northwestern Fukien, China. Collected in April by J. D. La Touche.

Description:—A handsome, bright ochraceous species with sharply marked boundary between the dorsal coloring and the white of the belly. The muzzle and forehead are dark brown slightly mixed with bright ochraceous hairs which predominate on the occiput and nape, but in the midline of the back the dark hairs are again more abundant, producing an ill-defined darker median area. On the sides of the cheeks, neck and flanks, the rump, arms and upper part of the hind legs, the fulvous ochraceous predominates, giving a handsome orange-yellow effect, and this tint is continued to the backs of the hands and the basal half of the metatarsals. Ears and upper surface of the tail dark brown, nearly hairless, the ears with short, scattered microscopic hairs, the tail with minute bristles, each slightly exceeding in length the scale-row it covers. Fingers, toes and sides of the fore and hind feet, the edge of the upper lip, and the entire under side of the body from the chin to the base of the tail, including the under side of the arms to the palm and the legs to a short distance above the ankle, pure white to the roots of the hairs, with a faint wash of buffy over the chest and abdomen. Tail white below, rather sharply marked off from the dorsal surface all the way to the tip, even the skin pale, with slight pigmentation of the scale-rows. Vibrissæ black.

Compared with the typical *R. f. fulvescens* of Nepal and western Yunnan, the coloring is duller, less ferruginous and more ochraceous, the fur somewhat

more hispid, at least in the southern specimens, the backs of the hind feet without dark markings.

The skull seems slightly larger but otherwise not very different from that of *R. f. fulvescens*. The line of beading is continued back along the edge of the parietals to the notch in the posterior border of that bone, and thence continues strongly across the parietal to the outer corner of the interparietal; the audital bullæ are usually slightly smaller than in *R. confucianus*.

Measurements.—The generally slender proportions are much as in typical *R. f. fulvescens*, with a tail considerably more than the length of head and body, but perhaps a very little shorter than in that animal, forming about 54-57 per cent of the total length instead of about 58-59 per cent, although with larger series these differences might disappear. The following measurements are from fresh specimens as recorded by the collectors:

No.	Head and body	Tail	Per cent of total length	Hind foot	Ear	Locality
44586	135	178	56	30.0	20.0	Fukien
44588	140	190	57	29.0	20.0	Fukien
44590	130	155	54	27.0	18.0	Fukien
44591	145	190	56	29.0	18.0	Fukien
44592	150	190	56	29.0	19.0	Fukien
44593	135	168	55	27.0	19.0	Fukien
44594	142	185	56	29.5	18.0	Fukien
44598	135	176	56	30.0	18.5	Fukien
44599	130	178	57	29.0	19.0	Fukien

For cranial measurements, see table under *R. f. fulvescens*.

Nomenclature.—After examining the series in the British Museum, including the type specimens of *Mus huang* and *M. ling* and others similarly labeled, I feel no hesitation in pronouncing the latter merely an immature individual of the former, of which the name is therefore a synonym. Osgood (1932) had independently reached the same conclusion, and furthermore was able to show that *M. huang* is merely an eastern subspecies of *Rattus fulvescens*, differing chiefly in the slightly less brilliant color and the lack of dusky marking on the backs of the hind feet. Shih (1930) had previously pointed out that *M. ling* could not be clearly distinguished from *M. huang* on the basis of foot measurements, since intermediates in size (and age) were found. Nevertheless, he proposed new names for both on the ground that the previous appellations, being Chinese words, were non-classical. His *R. flavipilis* as a substitute for *M. huang* (yellow) and *R. flavipilis minor* to take the place of *M. ling* are therefore to be regarded as pure synonyms of *M. huang*. Apparently, also, the same author's *R. wongi*, judging from the description and the small size of its bullæ, is but the same animal, from Yao Shan, Kwangtung.

Occurrence and Habits:—This is a common rat in parts of southern China but may be confused at times with *R. confucianus*, from which it differs in its usually brighter color, more hispid pelage, shorter ears and sharply bicolor tail, very seldom with a white tip above. In cranial characters the two are much alike, but *R. f. huang* has usually smaller bullæ and rather stronger post-orbital ridges, continued to the corners of the interparietal, although adults of *R. confucianus* may have these ridges equally well marked. The degree of spininess of the pelage varies considerably, and is apparently greatest in the more southern parts of the range, and possibly is more noticeable in summer than in winter pelage. Individuals taken at the same place on the same date may show a considerable difference in this respect. At the northern limits of the range two December specimens from Machu, southern Kansu, are fairly soft-furred, without noticeable bristles. In two specimens from Yenping, Fukien, taken in late April the new summer pelage is nearly complete, and is much more hispid than the remains of the winter fur on the head and neck.

In eastern China the most northerly record of this rat is from Kuatun, northwestern Fukien, where the type was taken, and other specimens were secured later by Mr. Clifford H. Pope at the nearby locality of Chunganh sien. Farther south, the Rev. H. R. Caldwell and Dr. Andrews found it abundant in the mountains at Yenping; Pope obtained a good series at Futsing and later brought back a number from Namfong and Nodoa in Hainan. He writes that although fairly common on Hainan, it was far less abundant than *R. losea exiguus*; in one day thirty or forty traps would never yield more than four and frequently none. It was distinctly confined to the jungle here, while the latter was equally characteristic of the stream banks flowing through rice fields, thirty or more traps set in both situations yielding only *R. f. huang* in the jungle growth and none in rice country. Caldwell notes on the label of one taken in the wooded mountains near Yenping that the "testicles were literally full of worms an inch long." He mentions, further, that the species nests in trees, for evidently this is a climbing rat with the long tail characteristic of climbing rodents. In two cases he found embryos in the Yenping series: two on July 28, three on August 2, indicating that the litters are small. Mell (1922) speaks of what is probably this same species as taken in his garden at Canton and once noted four embryos in a female captured May 23. Pope secured a very young one, perhaps a week old on June 8, at Chunganh sien, so that evidently the breeding season extends over several months of early summer. Doubtless the range is continuous across South China into the northern part of Indo-China, whence Osgood records typical *R. fulvescens* from Tongking, and is inclined to regard the Hainan examples as hardly different. In the western highlands of Szechwan this rat has not been found, but that it may extend to Kansu is indicated by a small series taken at Machu,

in the American Museum, and by two from Wenhsien in that province (recorded by Thomas, 1911d, p. 170, as *Epimys ling*). The specimens recorded by me (G. M. Allen, 1912) from Hupeh under the latter name prove to be *R. confucianus*.

Apparently this rat sometimes enters temples or other buildings but never seems to become a "house rat," preferring wooded country.

Specimens examined:—The following one hundred and ninety-six:

Fukien: Kuatun, 16, including type of *M. huang* (B.M.); Chunganh sien, 5; Futsing, 26; Yenping, mountains, 98; Chungfengling, 9, including the type of *M. ling* (B.M.); Yuki, 1.

Hainan: Namfong, 12; Nodoa, 19; Mount Wuchih, 2 (B.M.); Mount Ngautchilea, 1 (B.M.).

Kansu: Machu, 5; Wenhsien, 2 (B.M.).

436. *Rattus confucianus confucianus* (Milne-Edwards)

SULPHUR-BELLIED RAT

Mus confucianus Milne-Edwards, in David, Nouv. Arch. Mus. d'Hist. Nat. Paris, vol. 7, Bull., p. 93, footnote, 1871.

Epimys excelsior Thomas, Abstract Proc. Zool. Soc. London, February 14, 1911, p. 4; Proc. Zool. Soc. London, 1911, p. 170. Tatsienlu, Szechwan.

Epimys confucianus Thomas, Proc. Zool. Soc. London, 1911, p. 689.

Epimys jerdoni G. M. Allen, Mem. Mus. Comp. Zool., vol. 40, p. 224, 1912 (not of Blyth).

Epimys ling G. M. Allen, *ibid.*, p. 226 (not of Bonhote).

Rattus confucianus Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 9, p. 516, 1912.

Rattus confucianus littoreus Cabrera, Bol. Real Soc. Esp. Hist. Nat., Madrid, vol. 22, p. 167, 1922. Foochow, Fukien.

Rattus confucianus confucianus G. M. Allen, Amer. Mus. Novitates, no. 217, p. 8, 1926.

Rattus confucianus (sic) *yaoshanensis* Shih, Bull. Dept. Biol., Sun Yatsen Univ., Canton, no. 4, p. 6, 1930. Loshiang and Kutchen, Kwangsi.

Rattus jerdoni Shih, *ibid.*, p. 7.

Rattus confucianus sinianus Shih, Bull. Dept. Biol., Sun Yatsen Univ., Canton, no. 12, p. 3, fig. of skull, 1931. Yao Shan, Kwangtung.

Rattus elegans Shih, *ibid.*, p. 7. Yao Shan, Kwangtung.

Type specimen:—No type specimen is specified, but the description was based on specimens from "Setchuan," and in the fuller account in the "Recherches" the animal is said to inhabit Muping, which may then be taken as the type locality. No doubt some of the original series are still preserved in the Muséum d'Histoire Naturelle at Paris.

Description:—In general this is a small rat of slender proportions, tail longer than head and body, averaging about 56 per cent of the total length, hind foot about 30 mm. Color above, a mixed ochraceous and black, the black predominating in the mid-dorsal region and on the snout, but the ochraceous tints bright along the sides of the head, neck and body, varying individually from dull ochraceous to a bright nearly ferruginous color, which

may extend to the forearms and hind legs, or these parts may be grayer according to whether or not the under fur shows through. The center of the metacarpal area and the basal two-thirds of the metatarsals dusky, dark brownish. Ankles dusky gray high up on the tibia below. Ears rather large and thin, dark brownish, with many minute blackish-brown hairs on the proëctote and metentote. Vibrissæ black. Tail above blackish for the greater part of its length, its under side and usually more or less of its tip all around, white, the hairs slightly longer terminally. Under surface of the body, usually the upper lip and a spot at the base of the whiskers, the chin and throat, the under side of the fore limbs to and including the wrist, and of the upper half of the hind leg, white to the roots, with a faint sulphury suffusion, the white of the belly and sides sharply marked off from the coloring of the upper side.

There is much individual variation in large series as to the tint and the extent of dark or white marking. This, the typical subspecies, is the darkest of the races, with the mid-dorsal area noticeably clouded with long black hairs. The metapodials, too, are usually conspicuously marked with dusky at the basal two-thirds or so. The tail is always white below, and in about half the specimens white-tipped. In a series of seventy-six from Wanh sien, Szechwan, 31 or 40 per cent have white tips. Often the white tip may have little islands of dark color in the mid-dorsal line and may involve as much as the terminal third of the tail. Occasionally the white of the upper lip extends up to include the area at the base of the vibrissæ, forming a distinct white spot on either side of the muzzle. In about 25 per cent of specimens there is a central pigmented spot on the chest, varying from a small tuft of hair with gray bases to a broader area, in one case 8 by 10 mm., with slaty-based hairs and russet tips. The dark metatarsal area usually includes the ankle and bases of digits 2-5, with digit 1 usually all white; it may vary from fuscous to pale buffy or to dusky, and may extend rarely as far distally as the bases of the phalanges. Rarely the foot is entirely white.

January and February specimens are usually soft-furred and without spiny hairs, but by May when the summer pelage is being assumed these are to be found mixed in with the finer hairs. By September the moult to the winter condition commences, and in some individuals may not be completed until December when the softer pelage is completely assumed.

Measurements:—The long slender tail considerably exceeds the combined length of head and body, usually from 55 to 57 per cent of the total length, as the following measurements show. The ear is slightly larger than that of *R. fulvescens* and its eastern race, *R. f. huang*, averaging 21 mm. or over instead of 19, but the hind foot is about the same in both.

No.	Head and body	Tail	Per cent of total length	Hind foot	Ear	Locality
43307	135	172	56	27.0	22.0	Yunnan
43311	125	170	57	29.0	21.0	Yunnan
43314	130	170	56	29.5	21.5	Yunnan
43319	127	170	57	28.0	24.0	Yunnan
43324	130	168	56	29.0	23.0	Yunnan
43325	140	177	55	29.0	23.0	Yunnan
11.2.1.131 BM	148	193	56	30.0	23.0	Szechwan
(type of <i>E. excelsior</i>)						
11.2.1.130 BM	138	190	57	29.5	23.0	Szechwan
11.2.1.132 BM	155	197	56	32.0	27.0(?)	Szechwan
44604	143	187	56	30.0	—	Fukien
44616	160	200	55	29.0	20.0	Fukien

While the above measurements represent maximum size, the average of a large series, including adults and immature specimens, is of course much less.

CRANIAL MEASUREMENTS OF *RATTUS CONFUCIANUS*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
<i>R. confucianus confucianus</i>									
56548	36.2	30.5	18.3	15.6	14.5	6.9	5.6	5.7	Szechwan
7145 MCZ	35.9	30.3	17.5	13.9	12.4	6.8	5.6	5.8	Hupei
44621	33.5	28.5	16.5	15.3	14.4	6.3	5.2	5.5	Fukien
11.2.1.118 BM	38.8	33.1	19.2	16.7	13.8	7.3	6.4	5.9	Szechwan
11.2.1.121 BM	38.5	32.7	19.2	16.5	14.2	7.3	6.6	5.7	Szechwan
11.2.1.122 BM	35.8	30.0	17.4	16.0	13.2	7.3	5.8	5.7	Szechwan
11.2.1.124 BM	36.5	31.1	18.1	16.0	13.7	7.2	5.7	5.7	Szechwan
11.2.1.131 BM	38.4	32.5	19.4	16.4	14.8	7.5	6.9	6.9	Szechwan
(type of <i>E. excelsior</i>)									
11.2.1.130 BM	38.2	32.3	19.4	17.6	14.1	7.1	6.8	6.8	Szechwan
11.2.1.132 BM	(39.5)	34.3	21.2	18.9	—	7.7	7.1	(6.5)	Szechwan
<i>R. confucianus sacer</i>									
8.2.8.4 BM	36.5	31.4	18.6	16.4	14.1	7.4	6.0	5.7	Shantung
8.2.8.7 BM	37.4	32.1	19.1	16.6	13.8	7.4	6.2	6.5	Shantung
8.2.8.9 BM	37.7	31.7	18.7	16.7	14.6	7.8	6.1	6.0	Shantung
8.2.8.12 BM	37.8	32.5	19.3	17.1	13.8	7.9	6.0	5.8	Shantung
8.2.8.15 BM	37.8	31.9	18.7	16.5	14.5	7.3	5.8	6.0	Shantung
8.2.8.21 BM	35.8	30.5	18.3	16.0	13.2	7.4	5.9	5.7	Shantung
8.2.8.22 BM	36.8	31.1	18.7	16.0	14.0	7.3	6.0	5.7	Shantung
9.1.1.92 BM	35.2	29.8	17.4	16.4	14.6	6.9	5.9	5.5	Shensi
(type of <i>M. c. luticolor</i>)									
9.1.1.93 BM	33.7	28.7	17.0	15.5	12.4	7.0	5.8	6.0	Shensi
11.2.1.110 BM	34.0	28.5	16.4	15.3	12.6	7.4	5.8	5.7	Kansu
(type of <i>E. c. canorus</i>)									
11.2.1.104 BM	36.5	30.9	17.8	15.9	13.1	6.8	5.8	6.0	Kansu

CRANIAL MEASUREMENTS OF *RATTUS CONFUCIANUS* (Cont'd)

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
<i>R. confucianus chihliensis</i>									
56491	34.6	28.6	17.4	—	13.0	6.6	5.5	5.5	Hopei
56499	38.1	32.4	18.9	15.7	13.4	7.0	5.8	5.5	Hopei
56673	34.6	28.8	17.0	15.4	13.1	6.7	5.5	5.6	Hopei
56669	34.2	28.9	17.4	16.3	13.7	7.0	5.7	5.6	Hopei
<i>R. confucianus lotipes</i>									
58997	38.0	32.7	18.9	17.4	15.3	7.6	6.0	5.8	Hainan
59162	37.0	32.0	19.1	16.9	14.0	7.5	6.3	6.3	Hainan
59305	34.4	29.1	17.3	16.2	14.5	6.8	5.7	5.7	Hainan
59303 (type)	39.5	33.8	20.0	16.5	14.5	—	6.5	6.5	Hainan

Nomenclature:—Undoubtedly this rat is very closely related to *R. fulvescens*, which it resembles in size, color pattern, and general form of the skull. Both develop spines in the fur, but apparently this is true of the summer pelage only in *R. confucianus*, while *R. fulvescens* may be spiny in winter as well. The color of the latter is usually much brighter, shading to ferruginous, while the former is a duller ochraceous. A character that seems to separate the two is the greater size of the ears in *R. confucianus*, correlated with slightly larger ear bullæ of the skull. The tail-tip is frequently white all around, but in *R. fulvescens* is normally dark above and white below quite to the tip. Were it not for these peculiarities, one might readily believe that the two were merely forms of the same species, of which the individuals living under warmer conditions developed a somewhat spiny coat, while those in areas of cooler climate were soft-furred, for spininess seems to be correlated with the warm season of the year or with warmth of climate throughout the year. Poorly prepared specimens may even be difficult to identify with certainty, but generally the distinctions mentioned seem sufficient to separate the two species even where their ranges overlap. Occasional individuals attain large size, as frequently happens among rodents, and it was on such specimens that Thomas based his *Epimys excelsior* from Tatsienlu, but in a series from Fukien an even larger individual was found. Although Cabrera in 1922 named as a new race *R. c. littoreus*, the animal from Foochow, Fukien, I am unable to find characters of much importance in a large series from the southeast coast; while to recognize a distinct race here merely involves one in further difficulty to distinguish it from *R. c. sacer* to the north. These rats of southeastern China are really somewhat intermediate between the two, and, as intergrades, are nearer typical *R. c. confucianus*, to which they may best be referred. More recently Shih (1930) has named *R. c. yaoshanensis* from Kiangsi, basing his distinction on its lack of spines in the pelage, but as the type is a November

specimen, this is obviously a seasonal character. As far as one can judge from descriptions, this same author's *R. confucianus sinianus* and *R. elegans* may also for the present at least be best regarded as synonyms of *R. c. confucianus*. The former (*R. c. sinianus*) is based on very slight differences in the shape of certain bones, as the nasals and interparietal, but as his outline figures of the skulls and the measurements of the audital bullæ and the external ears show, these are doubtless purely individual in nature. The latter name, *R. elegans*, is said to refer to a small rat of the *confucianus* group, distinguished by its smaller size and darker color, but the dimensions given of the type, a "subadult," agree fairly well with those of immature specimens of *R. c. confucianus*, except that the ear, "31" mm., is a third longer than in this species. Assuming, however, that the figure given is a misprint for "21," there seems to be little doubt that the name is again based on *R. c. confucianus*, the immatures of which are at first sight often puzzlingly adult in appearance or vary in accordance with the state of the pelage, so that even Bonhote and Thomas have made similar mistakes.

Occurrence and Habits:—The larger ears, less hispid pelage, and duller color will usually distinguish this rat from the races of *R. fulvescens*. It is one of the commonest and most widespread of the Chinese rodents, from central Hopei to western Yunnan. Over this great area it maintains its general characters very well, with slightly differentiated races on the borders of its range. The dark, typical subspecies is found from the Likiang Range in northwestern Yunnan northward to southern Kansu, in the wooded portions, and thence eastward in South China to Fukien and the higher country of the southern provinces. The American Museum Asiatic Expeditions secured a large series from Likiang in Yunnan, and from Yenping, Futsing, and Chunganh sien in Fukien, all of which seem to represent but a single subspecies quite like a third series from Wanhsien in eastern Szechwan. There is considerable individual variation in the details of coloration, the amount of white on tail, feet, and muzzle, and in the extent of the dusky areas on the feet, but any attempt to subdivide local races over this wide area has hitherto proved unsatisfactory. In the northern part of the lower Yangtze basin a very gradual intergradation with the paler race *R. c. sacer* takes place, so that it is difficult often to place single specimens with one or the other race. In general, however, typical *R. c. confucianus* is darker than the northern races, with the dark metatarsal mark well developed. The summer pelage is usually more or less mixed with stiffer, spine-like hairs, which under a lens are seen to be flattened, with their edges slightly curved upward, forming a shallow channel the length of the spine. In altitudinal range the species was taken as high as 10,000 feet on the Likiang Range in northwestern Yunnan.



FIG. 50. Distribution Map.

Rattus

- | | |
|--------------------------------------|--------------------------------------|
| 1. <i>R. confucianus confucianus</i> | 3. <i>R. confucianus chihliensis</i> |
| 2. <i>R. confucianus sacer</i> | 4. <i>R. confucianus lotipes</i> |

In its habits this rat is more or less partial to rocky places with a cover of scrub, and is spoken of as a cliff rat. It is apparently an active climber, as its long tail would indicate. Very little is recorded of its habits. It is possibly not so prolific a breeder as its abundance would imply. At all events the only breeding record I have is of a female with four embryos on July 23, at Futsing, Fukien.

Sowerby (1929) writes that this species, as well as the "red-spiny" (*R.*

fulvescens huang) and gray field rats, are skinned, dried and used as food by the people of Fukien.

Specimens examined.—The following three hundred and thirty-seven:

Yunnan: Likiang, 55; Kaochiao, 1; Mekong-Salween divide, 1; Mucheng, Salween drainage, 6; Peitai, 14; Tugansha, 2; Yinpankai, 4; Yunnanfu, 8; Yunnanyi, 1; Minkai, 1; Peitaiping, 2; Hsiaokela, 1; Homushu Pass, 12; Talifu, 1; Lachumi, 1; Taipingpu, 2; Taishuitang, 3.

Szechwan: Nagchuka, 2 (M.C.Z.); Ramala Pass, 4 (M.C.Z.); Tatsienlu, 5, including the type of *Epimys excelsior* (B.M.); Wanhsien, 106.

Hupei: Ichanghsien, 1 (M.C.Z.).

Kansu: Machu, 10.

Fukien: Chunganhsien, 26; Futsing, 24; Kuliang, 5; Yenping, 39.

437. *Rattus confucianus sacer* (Thomas)

Mus confucianus sacer Thomas, Proc. Zool. Soc. London, 1908, p. 6 (published in June, 1908).

Mus confucianus luticolor Thomas, Abstract Proc. Zool. Soc. London, December 15, 1908, p. 45; Proc. Zool. Soc. London, for 1908, p. 972, 1909. Yenifu, Shensi.

Epimys confucianus Thomas, Proc. Zool. Soc. London, 1911, p. 689 (in part).

Epimys confucianus canorus Thomas, *ibid.*, p. 690. Wenhsien, Kansu.

Mus (Epimys) confucianus canorus Jacobi, Abh. u. Ber. Mus. f. Tier- u. Völkerk., Dresden, vol. 16, no. 1, p. 14, 1922.

Rattus confucianus sacer G. M. Allen, Amer. Mus. Novitates, no. 217, p. 10, 1926.

Rattus confucianus luticolor G. M. Allen, *loc. cit.*

Type specimen.—An adult male, skin and skull, No. 8.2.8.8, British Museum, from near Chefoo, Shantung, China. Collected March 30, 1907, by Malcolm P. Anderson.

Description.—In size and proportions this rat is similar to the typical race, but is a slightly paler, more buffy-gray color, without the dark markings on the backs of the feet. The tail is almost always white-tipped to a varying degree, in seventy-six of eighty-four specimens, and about a third of the specimens seen have the white of the upper lip extended dorsally to form a white spot at the base of the vibrissæ. The winter pelage is without spines and notably paler, more ochraceous buffy than that of summer.

Intermediate conditions occur in south-central China, and not all specimens from some localities, as the Tsingling Range, are easily referred to this or the typical race.

The skull is quite like that of *R. confucianus confucianus*.

Measurements.—In size the average adults are not different from the typical race, although in the series studied there are no very large ones, and the average is possibly a trifle less. The following are from fresh specimens, as entered by the collector on the labels:

No.	Head and body	Tail	Hind foot	Ear	Locality
45377	140	152	30.0	20.0	Shansi
45379	145	150	30.0	22.0	Shansi
56686	138	183	26.0	20.0	Hunan
56692	145	220	30.0	22.0	Hunan
9.1.1.92 BM (type of <i>M. c. luticolor</i>)	130	167	27.0 (s.u.)	23.0	Shensi
9.1.1.94 BM	115	149	27.0 (s.u.)	23.0	Shensi
8.8.7.34 BM	120	145	27.0 (s.u.)	20.0	Shansi
8.2.8.8. BM (type of <i>M. c. sacer</i>)	144	172	29.0 (s.u.)	20.5	Shantung
8.2.8.6 BM	132	167	28.5 (s.u.)	20.5	Shantung
8.2.8.7 BM	136	170	29.0 (s.u.)	21.0	Shantung
11.2.1.110 BM (type of <i>E. c. canorus</i>)	120	180	27.0 (s.u.)	21.5	Kansu

For cranial measurements, see table under *R. c. confucianus*.

Nomenclature.—This race is characterized by its lighter tints, having less dark or blackish in the back, and the flanks more buffy ochraceous, as well as by having the backs of the feet usually without dusky central marking. Moreover, the winter pelage is considerably paler than that of summer in correlation with the more northern habitat. After a study of the series at the British Museum, including the types of Thomas's *Mus c. luticolor* (from Yenanku, Shensi) and *Epimys c. canorus* (from Wenhsien, southern Kansu), I cannot see that these present differences from *R. c. sacer* worthy of subspecific recognition. The type of *Mus c. luticolor* is the palest individual of the series, all of which are in the paler winter pelage, and when compared with winter specimens from Shantung representing *R. c. sacer*, are quite the same. The original series on which *Epimys c. canorus* was based are, as Thomas says, darker than his *Mus c. luticolor*, but they are either changing or have already changed to summer pelage in mid-May. Two specimens from Minchow, Kansu (early March), are indistinguishable in any way from the Chefoo specimens representing *R. c. sacer*, while the type of *Epimys c. canorus* (May 7) is changing with more or less of the dorsal fur gone, and is scarcely different from that race. Eight other topotypes are apparently already in summer coat and are best considered intermediates between *R. c. sacer* and the typical race.

Occurrence and Habits.—The range of this pale-footed race of north temperate China includes the more arid country from the Shantung peninsula on the east, westward across most of Shansi and Shensi to the central or western parts of Kansu, north of the forested country. Southward it extends to the Yangtze basin where intergradation takes place to the west and south with the typical race. To the northeastward it grades into the race *R. c. chihliensis*, as noted by A. B. Howell. A series from Hunan (Yochow) shows characters more or less intermediate between *R. c. sacer* and the typical *R. c. confucianus*,

so that the race is not very sharply defined. Jacobi (1922) records as *M. (E.) c. canorus* a specimen from Sungpan, northwestern Szechwan, which may be this.

The rock-living habits of this rat are mentioned by Sowerby (Clark and Sowerby, 1912, p. 178), who captured a series in the mountains near Sianfu and Yenanku, Shensi. He found them usually along the rocky sides of ravines and valleys, among trees and bushes. They frequently were much infested with ticks and fleas. From a specimen taken at Yenanku, a new species of flea, *Ceratophyllus subcæcatus*, has been described; while in another, parasitic worms were taken from the stomach. Anderson, who collected the type series of *R. c. sacer*, notes that they were common among the rocks in the temple-woods near Chefoo, but were rarely met with elsewhere. "In the sacred woods it feeds mostly on acorns, leaving large accumulations of the shells in cavities beneath the rocks."

Thomas supposed his *M. c. laticolor* to be "a pale desert form," but the species does not extend into the Ordos Desert, though occurring in rocky and bush-grown country nearly to its edge.

Specimens examined.—The following one hundred and sixty-nine:

Shantung: Chefoo, 5, including the type (B.M.); Aisan, thirty miles west of Chefoo, 2 (B.M.).

Shansi: Heshuin, 10; Taiyuanfu, 2 (B.M.).

Shensi: base of Taipai Shan, 86; forty-five miles south of Fengsiangfu, 6, 1 (B.M.); Shangchow district, 1 (B.M.); Yenanku, 3, including the type of *M. c. laticolor* (B.M.).

Kansu: Wenhsien country, 9, including type of *E. c. canorus* (B.M.); near Sihohsien, 2 (B.M.); Choni, 13 (M.C.Z.); sixty miles south of Minchow, 2 (B.M.).

Hunan: Yochow, 27 (more or less intermediate), perhaps nearer *R. c. confucianus*.

438. *Rattus confucianus chihliensis* Thomas

Rattus confucianus chihliensis Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 20, p. 199, 1917.

Mus confucianus Thomas, Proc. Zool. Soc. London, 1908, p. 641 (in part).

Type specimen.—An adult male, skin and skull, No. 8.8.7.31, British Museum, from the Eastern Tombs, sixty-five miles east of Peiping, Hopei, China. Collected September 17, 1907, by Malcolm P. Anderson.

Description.—This northern race is very much like *R. c. sacer* in color, but differs in having a shorter tail, which is more nearly equal to the head-and-body length, sometimes slightly more but usually a trifle less, averaging about 49 per cent of the total length. In winter pelage the coat is mixed black and pale ochraceous above, with black predominating in the mid-dorsal area, but diminishing laterally so that the flanks and sides of the neck are nearly clear

"pale ochraceous," and on the lower cheeks and fore limbs clear buff. Backs of the feet and the upper lip white, the former, however, occasionally with a dark metatarsal area centrally. Ears brown. Tail bicolor with its terminal half more hairy, becoming slightly penicillate, and more or less of the tip white all around, for at least the last fourth. Lower surfaces to the wrists and on the hind legs to the terminal third of the tibia, white to the roots of the hairs, with a pale buffy suffusion. In summer the fur of the back becomes partly hispid, with pale grayish bases, and much darker than in winter, due to the greater abundance of black hairs, but the ochraceous tints are rather paler than in *R. c. sacer* to the south.

The skull is like that of the typical race, with perhaps on the average slightly shorter incisive foramina.

Measurements:—None in the considerable series examined attains so large a size as do some individuals of the more southern races, so that an average of smaller size may be regarded as one of the characters. The shortness of the tail, usually slightly less than the head and body, is the most striking peculiarity of this race, as may be seen in the following measurements taken in the field:

No.	Head and body	Tail	Per cent of total length	Hind foot	Ear	Locality
56486	140	135	49	28	21	Hopei
56487	149	132	47	27	21	Hopei
56489	163	144	47	29	20	Hopei
56490	135	139	50	26	20	Hopei
56497	135	129	49	29	20	Hopei
56499	150	142	48	28	22	Hopei
56500	140	123	46	27	20	Hopei
56674	140	135	49	28	20	Hopei
56675	135	144	51	29	21	Hopei
56677	143	129	47	30	21	Hopei

Of twenty-five specimens the average length of the tail is 48.7 per cent of the total length.

For cranial measurements, see table under *R. c. confucianus*.

Occurrence and Habits:—This is a slightly differentiated race, and the most northerly of the subspecies, with a shorter tail than in the southern races. As A. B. Howell remarks, specimens from east of Taiyuanfu, Shansi, "might almost as well be placed" with this race, for obviously intergradation with *R. c. sacer* takes place over this area. It is apparently common in the region about the Eastern Tombs, east of Peiping, where M. P. Anderson found it "among broken rocks and canyon bottoms on hillsides," for, as elsewhere, it is a rock-living species found where a scrubby growth is present. According to Sowerby, they are easily trapped but appear to do little or no damage to crops,

no doubt because their fondness for a rocky habitat does not bring them into close contact with agricultural areas. The same author mentions their eating carrion and other animal refuse as a favorite food, or even attacking sick people, "and some grisly tales are told of wood cutters or charcoal burners, who, working alone in out of the way places, and having fallen ill, have been horribly gnawed before help could reach them."

The range extends from central Hopei northward and eastward to the borders of Manchuria near Fengtien, but the extreme limits of its distribution remain to be worked out. Specimens have been taken in the Eastern Tombs region and at Chinwangtao (A. B. Howell, 1929).

Specimens examined.—The following twenty-seven:

Hopei: Eastern Tombs, 24 (A.M.N.H.), 2 (B.M.); one hundred miles northeast of Peiping,
I.

439. ***Rattus confucianus lotipes*** G. M. Allen

Rattus confucianus lotipes G. M. Allen, Amer. Mus. Novitates, no. 217, p. 11, 1926.

Type specimen.—An adult female, skin and skull, No. 59303, American Museum of Natural History, from near Nodoo, Hainan, China. Collected February 9, 1923, by Clifford H. Pope of the Central Asiatic Expeditions.

Description.—This race is characterized by the combination of a brighter and deeper ochraceous coloring, especially of the flanks, than the typical race of the neighboring mainland; the paler color of the back due in part to the showing through of the pale-gray bases of the hairs; the white feet, lacking the dark metapodial area; the sharply bicolor tail, dusky above and white below; the sulphury tint of the belly; and by the fact that the coat is spinous in summer as well as in winter.

The degree of darkness in the color of the back varies, but usually the ochraceous tints predominate, especially on the sides and nape, and are clear on a narrow line along the sides of the body; some adults are prevailingly ochraceous. In over thirty specimens the tail is almost without exception dark above quite to the tip, while the ventral half is white both as to the hair and the skin. In a few there is a slight buffy tinge to the backs of the hind feet, but the dusky mark so characteristic of typical *R. c. confucianus* is lacking. The belly is more noticeably sulphur-tinted than in the northern races, and the white of the upper lip shows no tendency to extend upward about the base of the vibrissæ, so that the bright ochraceous of the lower cheeks extends across uninterruptedly from the muzzle back along the side of the head.

The skull presents no especial peculiarities except that in old animals it may reach a large size and be slightly more heavy of bone.

Measurements:—The body size is not different from that of the typical race, with the tail longer than head and body, forming about 56 per cent of the total length. The largest of over thirty specimens had the head and body 165 mm., tail 180, a total length of 345 mm. The nine largest of this series were measured by the collector as follows:

No.	Head and body	Tail	Per cent of total length	Hind foot	Ear	Locality
58978	165	180	52	30	23	Hainan
58990	150	205	57	32	22	Hainan
58997	150	206	57	31	24	Hainan
59019	150	200	57	31	22	Hainan
59265	160	200	54	29	23	Hainan
58972	154	182	54	31	22	Hainan
58973	150	191	58	32	24	Hainan
58974	158	215	57	—	23	Hainan
58971	150	185	55	31	23	Hainan

For cranial measurements, see table under *R. c. confucianus*.

Occurrence and Habits:—This white-footed race of the Sulphur-bellied Rat is a discovery due to the energetic field work of Mr. Clifford H. Pope who secured a handsome series at Nodoa and a few others at Namfong in the island of Hainan. It differs notably from the typical race of western and southern China in its white feet and in having a hispid pelage throughout the year, while in response to its warmer habitat, the colors are brighter above, and the yellowish tint of the belly more intense. The small dark chest spot occasional in the mainland animal is usually absent, but is developed in one individual so as to form a nearly complete collar, barely broken in the midline.

It is interesting that this species had not been reported from Hainan previous to Mr. Pope's work, although possibly Swinhoe may have confused it with *R. fulvescens huang*, also common at the same localities above mentioned. It may, however, be distinguished by its lack of the ferruginous tints of the latter, being duller and ochraceous instead, and by its longer ear, of 22 mm. or over, against 21 mm. or less (usually 19 mm.) in *R. f. huang*. The series is from the mountainous country near which Mr. Pope was stationed.

Specimens examined:—The following forty-nine:

Hainan: Nodoa, 44; Namfong, 5.

440. *Rattus andersoni* (Thomas)

Epimys andersoni Thomas, Abstract Proc. Zool. Soc. London, February 14, 1911, p. 4; Proc. Zool. Soc. London, 1911, p. 171.

Epimys zappeyi G. M. Allen, Mem. Mus. Comp. Zool., vol. 40, p. 225, 1912. Wa Shan, Szechwan.

Rattus andersoni Thomas, Ann. Mag. Nat. Hist., ser. 9, vol. 10, p. 403, 1922.

Rattus excelsior zappeyi G. M. Allen, Amer. Mus. Novitates, no. 217, p. 13, 1926.

Rattus andersoni (sic) Shih, Bull. Dept. Biol., Sun Yatsen Univ., Canton, no. 4, p. 6, 1930.

Type specimen.—An adult female, skin and skull, No. 11.2.1.135, British Museum, from Omei Shan, Szechwan, China. Collected August 8, 1910, by Malcolm P. Anderson for whom it was named.

Description.—A medium-sized rat of slender build, tail considerably longer than head and body, belly pure white, tail-tip white.

The general coloration rather closely resembles that of *R. confucianus* which occurs over the same region: the muzzle and forehead are a mixed dark grayish and ochraceous, slightly paler than the mid-dorsal region of occiput, nape and body, which is a mixture of the usual black and ochraceous, the former prevailing so that the back is decidedly dark; on the sides of the cheeks, neck and body, the black hairs are few, so that an almost clear ochraceous buff colors this area. A contrasted dark blackish area extends from the base of the vibrissæ back to the eye and about half-way to the base of the ears which are clothed with minute blackish-brown hairs, contrasting with the surrounding russet tone of the pelage. The forearms are dusky or dark grayish, and this color extends to the base of the digits on the back of the hands and hind feet, while the toes and sides of the feet are white. Tail bicolor, the upper surface and often more or less of the lower side at the base, dark blackish brown, with the tip, including the terminal third to a quarter of its length, and the rest of the under side white, the hairs toward the end slightly longer than those at the base. The under side of the body, including the arms and wrists, and the under side of the hind legs to the knee, pure white to the bases of the hairs, sharply limited along the sides by the ochraceous of the flanks. A small area of dark-based hairs with ochraceous tips often forms a spot of color in the center of the chest. In most specimens the white of the under side extends to the upper lips and anteriorly upward to include the area at the base of the vibrissæ.

The skull, though resembling that of *R. confucianus* in general form and in the rather flattened profile, differs in a number of details, in addition to its larger size. The nasals are long and narrow, truncate posteriorly where they slightly exceed the premaxillæ in backward extent. The interparietal is relatively of greater width anteroposteriorly, and the postorbital ridges, though of the same widely bowed outlines, are rather less heavy, usually fading out more or less on reaching the step or notch on the lateral border of the parietal.

Measurements.—In this species the tail is even longer in proportion to the head and body length than in the largest specimens of *R. confucianus*, and the total length in fully grown animals is likewise somewhat greater. Thus in three examples the tail constitutes 60 per cent of the total length and in one it

is 61, with an average of 58 per cent. The feet and ears are also larger. The following measurements are those of the largest in a series of 35:

No.	Head and body	Tail	Per cent of total length	Hind foot	Ear	Locality
43276	180	247	57	35	27.5	Yunnan
43285	180	237	56	36	28.0	Yunnan
43286	180	235	56	35	27.0	Yunnan
43287	180	215	54	35	25.0	Yunnan
43288	185	233	56	35	22.0	Yunnan
43289	198	260	55	35	28.0	Yunnan
43290	190	236	55	33	23.0	Yunnan
43274	150	240	61	35	27.0	Yunnan
11.2.1.135 BM	164	248	60	37	26.5	Szechwan
22.9.1.88 BM	178	268	60	35	29.0	Yunnan
22.9.1.86 BM	165	231	58	34	27.0	Yunnan

CRANIAL MEASUREMENTS OF *RATTUS ANDERSONI*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
43289	43.0	37.3	22.0	21.0	15.0	8.3	7.6	7.7	Yunnan
43294	42.3	36.3	21.3	20.5	15.8	7.3	7.6	7.6	Yunnan
43274	41.7	35.4	21.0	(19.0)	14.8	—	7.5	7.6	Yunnan
43276	43.0	37.5	22.1	21.0	15.0	—	7.5	7.3	Yunnan
43285	44.4	37.5	22.0	20.5	15.2	—	7.6	7.5	Yunnan
43286	43.0	37.5	22.4	20.5	15.3	—	7.5	7.6	Yunnan
43290	42.3	36.7	21.2	20.4	15.5	—	7.8	7.8	Yunnan
11.2.1.135 BM (type)	42.2	(37.5)	22.0	—	15.8	8.0	8.1	8.0	Szechwan
22.9.1.88 BM	44.0	39.5	22.2	—	15.3	8.2	7.6	7.4	Yunnan
22.9.1.86 BM	41.6	35.8	20.6	19.1	14.6	8.0	7.1	7.3	Yunnan

Nomenclature.—On further study there appears to be no doubt that the rat I described in 1912 as *Epimys zappeyi* is an immature example of this species, hence the name becomes a synonym of *R. andersoni*. It seems probable that the rat described by Thomas in 1917 as *Rattus culturatus* is the Formosan representative of the same animal.

Occurrence and Habits.—While in general appearance Anderson's Rat resembles *R. confucianus* which is found with it in the Chinese highlands, it may be distinguished at once by the pure white belly which lacks the faint sulphury wash of the latter; in addition the ears are usually more blackish instead of a distinct brown, and there is a prominent dusky area in front of the eye and surrounding it. About half the specimens have a dark chest spot which may vary in extent from a few gray-based hairs to a well-defined streak, 20 mm. in length, consisting of hairs with gray bases and ochraceous tips. This rat seems to be characteristic of the moist woodland areas of western China, and

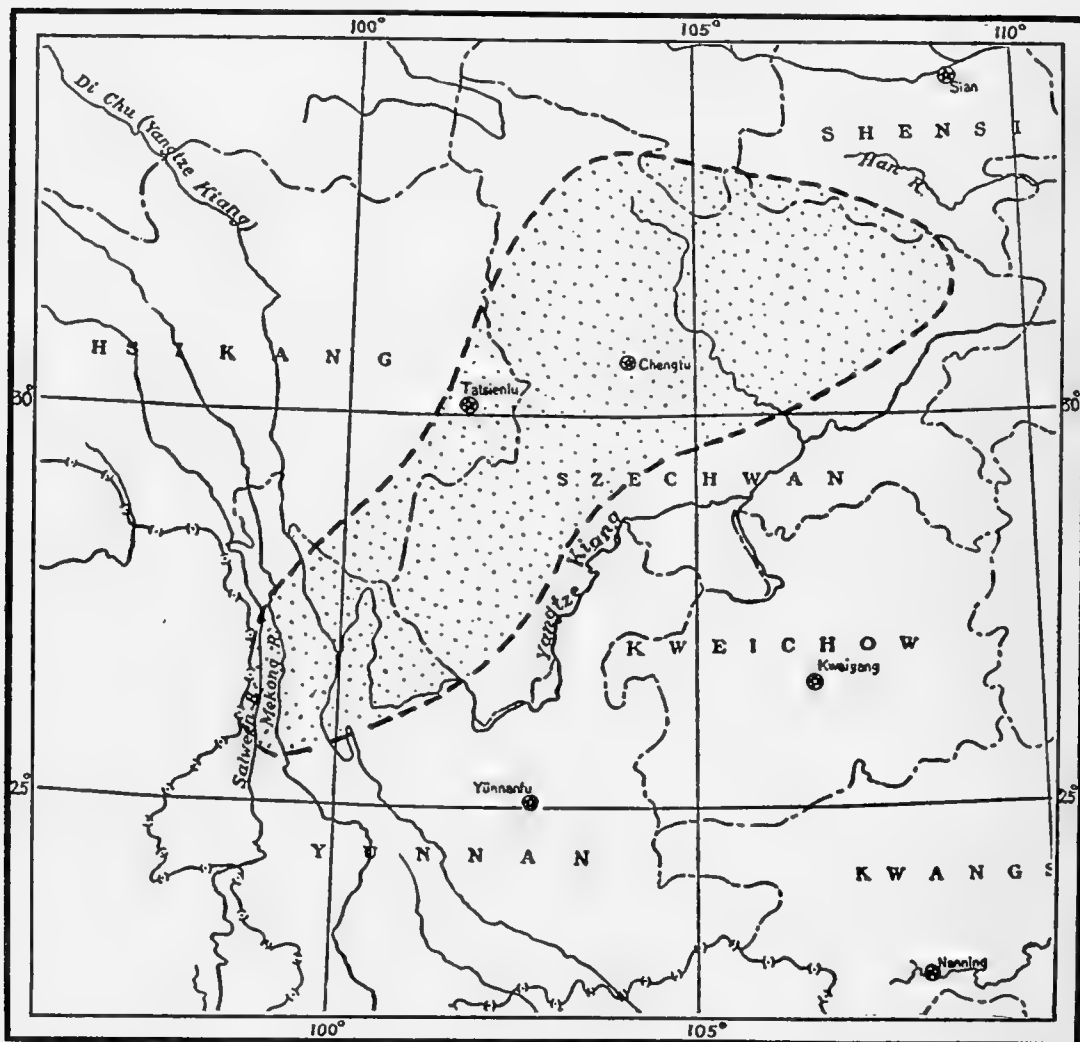


FIG. 51. Distribution Map.
Rattus andersoni

no doubt is to some extent arboreal in habits as the long tail would imply. The type came from Omei Shan, central Szechwan, where it was obtained by Anderson in 1910, while the type of my *E. zappeyi*, now made a synonym, was described soon after, from Wa Shan, a short distance to the southwest. Since then Thomas (1922b) has recorded half a dozen others from the Mekong valley, extending its range to Yunnan, at altitudes of from 6,000 to 9,000 feet. The collector's note mentions that two of these were trapped on open meadows and a third in scrub growth. The collections made by Dr. R. C. Andrews resulted in the discovery of the species on the Likiang Range in northwestern Yunnan, at altitudes up to 9,000 (Ssushanchang) and 10,000 feet (Peishui), and some-

what farther north at Yinpankai, and at Peitai, thirty miles south of Chung-tien, 10,000 feet. Others were taken at Lachumi on the Mekong River and at Peitaiping. Finally an interesting extension of the known range was made in the discovery of the species at Taipai Shan on the southern borders of Shensi, a locality that probably marks nearly the northeastern bounds of the range as with so many other species of the highland fauna. It is apparently not common wherever it occurs, for after long and intensive collecting less than thirty were taken. How far to the southeast it extends must be determined by future collecting, but doubtless it will be found across much of the wooded highlands of southern China. Indeed, Shih (1930, p. 6) has recorded it from three different places in the Yao Shan area of Kiangsi, but in view of the difficulties experienced by this author in the identification of his collections without the advantage of comparative material, the record might bear confirmation.

Specimens examined:—The following thirty-six:

Shensi: Taipai Shan, 1.

Szechwan: Omei Shan, 1, the type (B.M.); Wa Shan, 1, type of *Epimys zappeyi* (M.C.Z.).

Yunnan: Likiang, 9,000-10,000 feet, 13; thirty miles south of Chungtien, 5; Peitaiping, 3; Lachumi, Mekong River, 1; Yinpankai, 9,000 feet, 5; Mekong valley, 5 (B.M.); Mekong-Yangtze divide, 1 (B.M.).

441. *Rattus eha ninus* Thomas

SMOKY-BELLIED RAT

Rattus eha ninus Thomas, Ann. Mag. Nat. Hist., ser. 9, vol. 10, p. 404, 1922.

Type specimen:—An adult female, skin and skull, No. 22.9.1.107, British Museum, from the Kiukiang-Salween divide, 28° north latitude, and 11,000 feet altitude, western Yunnan. Collected August 19, 1921, by George Forrest.

Description:—Compared with typical *R. eha* of Sikkim, this is a well-marked race, duller and darker in color. In its general size and proportions it closely resembles *R. confucianus*, but is at once distinguished by its smoky belly, with gray-based hairs, black ears and ear tufts, and dark feet. Muzzle and a band from the base of the whiskers through the eye, blackish and not sharply marked; forehead and mid-dorsal area, mixed ochraceous and black, the long black hairs prevailing, but quickly giving place on the sides to ochraceous-tipped hairs, so that the sides of the neck and the flanks are clear and bright ochraceous, but not so ferruginous as in the typical race. Backs of the hands and feet dusky with very little white at the sides, the toes whitish. Ears very thinly haired, large and blackish, their substance also blackish brown, and a tuft of black hairs at their anterior base, making a strong contrast with the surrounding pelage of ochraceous. Tail blackish above, both the skin and the very short stiff hairs, which do not conceal the scale rings; lower surface

paler, the skin pigmented but the hairs with dark bases and whitish tips as seen with a lens. The hair of the entire under surface of the body and limbs is gray-based with short whitish tips, so that the gray shows through and adds to the smoky appearance of the ventral side. Vibrissæ long and conspicuous, black, sometimes arising from a white lip-spot.

The skull is long and slender, delicately formed, with the interorbital region finely beaded, but this ridge soon tails out, and is not sharply marked behind the front corner of the parietal to the interparietal. The interorbital space is very narrow, about as wide as the combined anterior width of the nasals.

Measurements.—The slender form, long tapering tail, and the long and narrow hind foot are the striking features of this rat. The tail in the type series varies between 53 and 63 per cent of the total length, averaging 59 per cent in the five specimens. The measurements of these as entered by the collector on the labels are:

No.	Head and body	Tail	Per cent of total length	Hind foot	Ear
22.9.1.95 BM	110	187	63	27 (s.u.)	22
22.9.1.103 BM	92	160	63	25 (s.u.)	20
22.9.1.104 BM	116	132	53	27 (s.u.)	16
22.9.1.105 BM	114	152	57	25 (s.u.)	18
22.9.1.106 BM	115	174	60	29 (s.u.)	19
22.9.1.107 BM (type)	127	180	58	27 (s.u.)	20

If the ear measurement of the first specimen listed be discounted as having been taken in a slightly different way from that of the others, the ear length will be seen to resemble that of *R. fulvescens*, but the coloration is quite different in the possession of black ears and ear tufts, a mixed gray belly, and only faintly bicolor tail, with its skin dark-pigmented on the lower side instead of white. The same characters will separate it from rats of the *R. confucianus* group.

CRANIAL MEASUREMENTS OF *RATTUS EHA NINUS*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
22.9.1.102 BM	31.4	25.4	14.4	—	13.3	6.5	5.0	5.1	Yunnan
22.9.1.103 BM	31.5	25.8	15.4	—	13.3	6.5	5.5	5.5	Yunnan
22.9.1.106 BM	30.7	25.2	14.4	12.5	12.6	6.1	5.1	5.1	Yunnan
22.9.1.107 BM (type)	31.7	—	15.4	13.7	13.0	6.5	5.2	4.8	Yunnan

Occurrence and Habits.—Hitherto this rat has not been found in China except by Forrest, who secured, in all, seven specimens, five from the Kiukiang-Salween divide and two in the Mekong valley in western Yunnan. It is evidently a duller-colored race of the bright fulvous *R. eha* of Sikkim and

Nepal, here perhaps near the northeastern limit of the animal's range. Across the border on Imaw Bum, Burma, a specimen indistinguishable from this sub-species has been taken. The collector's notes tell that three of the specimens were taken amongst alpine rocks at altitudes between 8,000 and 11,000 feet, one in scrub at 8,000 feet and one in forest at 11,000 feet. No doubt it is to some extent a tree climber, but the long slender feet indicate a preference for ground living.

The specific name is given in honor of E. H. Aitken, a naturalist of India, whose pseudonym he wrote as *Eha*.

Specimens examined:—The seven of the original series:

Yunnan: Kiukiang-Salween divide, 5, including the type (B.M.); Mekong valley, 2 (B.M.).

442. *Rattus edwardsi edwardsi* (Thomas)

MILNE-EDWARDS'S GIANT RAT

Mus edwardsi Thomas, Proc. Zool. Soc. London, 1882, p. 587, pl. 44.

Rattus edwardsi Cabrera, Bol. Real Soc. Esp. Hist. Nat., Madrid, vol. 22, p. 167, 1922. G. M. Allen, Amer. Mus. Novitates, no. 217, p. 16, 1926.

Mus melli Matschie, in Mell, Arch. f. Naturgesch., vol. 88, sect. A, no. 10, pp. 26, 37, 1922. Mahutze Shan, Kwangtung.

?*Mus validus* Mell, Arch. f. Naturgesch., vol. 88, sect. A, no. 10, p. 27, 1922.

Rattus edwardsi edwardsi A. B. Howell, Proc. U. S. Nat. Mus., vol. 75, art. 1, p. 64, 1929.

Type specimens:—Thomas expressly states that the species is based on four specimens mounted in the Muséum d'Histoire Naturelle at Paris, one of which was later given to the British Museum. All are therefore cotypes. They were collected in the high mountains of western Fukien, China, by Père Armand David in October, 1872.

Description:—This is a large, dull-brown, white-bellied rat, with a color pattern much like that of *R. c. confucianus*, but the hind foot very much larger, about 50 mm., and the body proportionately large. The general color above, from muzzle to root of tail, is a mixture of dull ochraceous and black, the long black hairs more numerous in the mid-dorsal region and fewer at the sides of the body, producing a color much like that of *R. norvegicus*. Central portion of the backs of the feet and hands, dusky, or dark brown, the sides of the feet and the tips of the toes white. Ears relatively small and nearly naked, their substance dull brown and thinly covered with minute blackish hairs visible only with a lens. Tail longer than head and body, bicolor, blackish brown above, white below, the very short hairs not concealing the scale-rows. Lower surfaces of body and limbs pure white to the bases of the hairs, including the upper lip and a prominent spot at the base of the vibrissæ. The white extends on the hind leg only to the proximal half of the tibia; the tip of the tail also may be white all around.

The skull is proportionately large and strong, long and narrow, in general shape much like that of the *R. confucianus* group, with a wide and rather flat brain case. The nasals extend back to the level of the ends of the premaxillæ, or may slightly exceed them. The interparietal, though more or less lozenge-shaped, tends to lack the median point anteriorly, but has a nearly transverse anterior outline, very slightly and evenly bowed forward. The supraorbital ridges are strongly developed from the middle of the orbit backward and outward to the notch on the parietal border, posterior to which they are very faintly continued to the outer corner of the interparietal. The audital bullæ are proportionally small, the incisive foramina short, not extending back to the level of the molars. In large skulls the postero-inferior border of the jugal often shows a small projection.

Measurements.—The large size of the animal and its proportionally short ears are evident from the following field measurements:

No.	Head and body	Tail	Hind foot	Ear	Locality
44584	260	322	52	32.0	Fukien
84599	275	325	52	35.5	Fukien
84612	272	323	50	31.0	Fukien
84616	260	319	49	33.0	Fukien
84618	300	340	—	36.0	Fukien
84624	290	320	—	35.0	Fukien
84629	270	320	52	35.0	Fukien
84606	247	300	49 (s.u.)	32.0	Fukien
84611	290	330	47 (s.u.)	33.0	Fukien
84608	270	340	50	32.0	Fukien

The tail forms about 55 per cent of the total length.

CRANIAL MEASUREMENTS OF *RATTUS EDWARDSI*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
<i>R. edwardsi edwardsi</i>									
82.6.16.1 BM (cotype)	56.8	—	26.1	26.2	20.6	11.8	10.5	10.5	Fukien
97.6.6.4 BM	56.1	47.7	28.2	24.7	19.5	10.8	10.2	10.1	Fukien
5.6.1.10 BM	60.4	52.8	31.4	26.5	21.3	11.6	10.5	10.5	Fukien
84606	58.0	50.2	29.5	26.0	19.5	12.0	11.0	10.5	Fukien
84607	60.5	52.0	30.8	—	21.0	12.0	10.6	10.5	Fukien
84608	60.0	51.8	30.0	—	21.0	11.8	10.0	9.7	Fukien
84612	61.3	53.0	31.3	27.0	19.6	12.0	10.5	10.0	Fukien
84629	61.1	53.0	30.3	27.4	20.0	12.5	10.8	10.2	Fukien
84638	61.8	52.8	31.3	26.4	20.8	12.4	10.5	10.0	Fukien
84643	59.0	50.0	30.0	26.5	19.8	12.0	11.4	11.0	Fukien
<i>R. edwardsi gigas</i>									
USSR (type)	59.0	47.0	—	25.7	19.0	—	11.0	11.0	Szechwan

Occurrence and Habits:—This and *R. b. latouchei* are the largest of the Chinese rats. Père David, who secured the first specimens of *R. edwardsi*, found them living amongst rocks in the mountainous country of western Fukien, probably in the region of Kuatun, where La Touche, Clifford H. Pope and others have since found it. Mr. Pope collected a large series on the highest of the ranges of low mountains near Futsing, where it was abundant on the slopes covered with thickets, woods and grass. They were apparently not present on the lower hills. The people of this region utilize them gladly as food, and maintain that "during the winter months they are readily caught beneath boulders on wild rocky mountain sides but that during the summer and late spring they

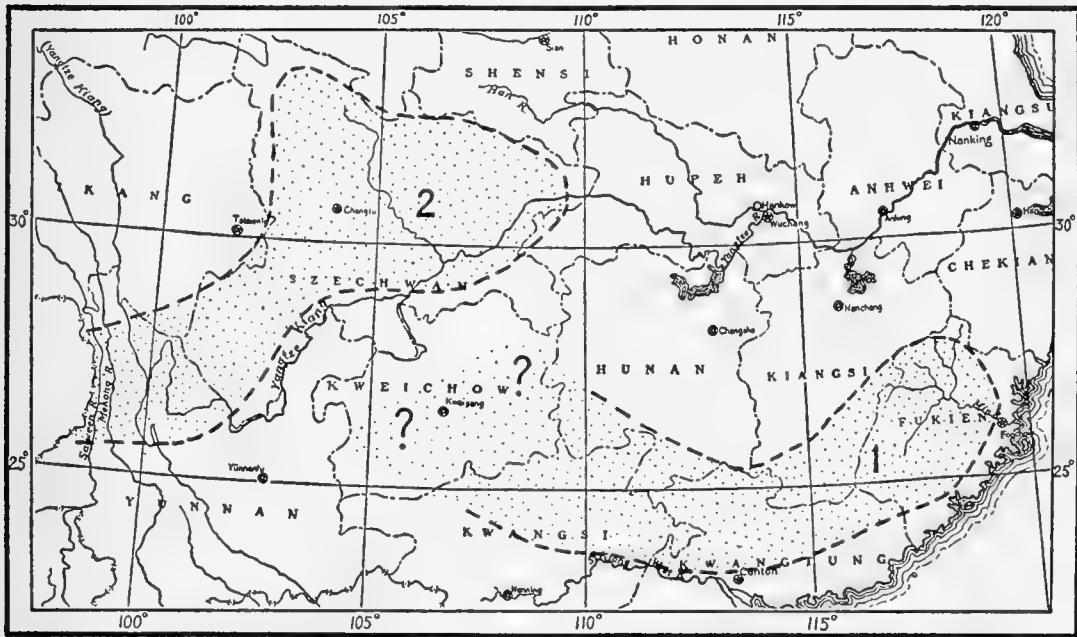


FIG. 52. Distribution Map.

*Rattus*1. *R. edwardsi edwardsi*2. *R. edwardsi gigas*

are no longer to be found in these places," a source of much mystery to the natives. In addition to specimens from Kuatun, Futsing, Yenping and Chunganh sien, in the mountains of Fukien, this Giant Rat has been reported by Cabrera from Foochow in the same province. Shih (1930) has reported it from Yao Shan in Kwangsi, while still farther south it was found by Mell in the mountain forest at higher elevations in Kwangtung, as at Mahutze Shan. He says that the flesh is well flavored and is highly prized by the natives who catch the animals in cleverly made bow traps of bamboo. It was on the basis

of his collections that Matschie described *Mus melli*, which, however, appears to be quite the same as *R. e. edwardsi*. Possibly, too, the rat listed as "*Mus (validus?)*" in Mell's field notes, a large rat seen several times in bushy woods near Canton by day, is this same species. Probably the range extends across southern China westward more or less continuously in the mountainous country, for in Szechwan it is represented by a slightly different race, *R. e. gigas*, but it is apparently rare. As shown by Osgood (1932), the general range of the species extends into western India, Assam, the Malay Peninsula and Sumatra, with various slightly marked subspecies.

There are eight mammae, two pairs pectoral and two abdominal, so that there must usually be more young in a litter than the only record at hand might indicate, namely, two embryos in a specimen taken July 28, 1916, at Futsing by Mr. Pope.

Specimens examined:—The following fifty-six:

Fukien: western mountains, 1, a cotype (B.M.); Kuatun, 4 (B.M.); Futsing, 40; Chunganh sien, 5; Yenping, 6.

443. *Rattus edwardsi gigas* (Satunin)

Mus gigas Satunin, Annuaire Mus. Zool. Acad. Imp. Sci. St. Pétersbourg, vol. 7, p. 562, 1902.

Rattus edwardsi gigas A. B. Howell, Proc. U. S. Nat. Mus., vol. 75, art. 1, p. 64, 1929. Osgood, Publ. Field Mus. Nat. Hist., zool. ser., vol. 18, p. 311, 1932.

Type specimen:—A skin and skull (number not given), in the Museum of the Academy of Sciences at Leningrad, U. S. S. R., from Chodsigou valley near Lunganfu, northern Szechwan, China. Collected November 16, 1893, by the explorer M. Berezovski.

Description:—In general this race is very similar to the typical subspecies of southeastern China, but differs in having a much softer pelage, not harsh as in the latter, so that when winter skins of both are compared, those of *R. e. gigas* may be distinguished even by the touch, so much softer are they. The color is practically the same in both, except that the darker area of the back tends to be more extensive and the ankles darker. The vibrissæ usually do not arise from a white spot as they do in typical *R. e. edwardsi*, but instead the muzzle is dark. Occasionally a small, median tawny spot may be present in the center of the chest. Some specimens have the tail all dark above, quite to the tip; others, perhaps half the number examined, have the end white above as well as below.

The skull is like that of the typical race.

Measurements:—The following external measurements are from fresh specimens:

No.	Head and body	Tail	Hind foot	Ear	Locality
58279	261	316+	55	38	Szechwan
58280	260	305	60	38	Szechwan
84369	252	300	55	35	Szechwan
84869	265	320	54	32	Szechwan
84870	285	325	56	37	Szechwan
84873	247	335	55	35	Szechwan
84874	216	286	52	37	Szechwan

Skull measurements of the type are given in the table under the typical race.

Occurrence and Habits.—The giant rat is evidently rare or uncommon in the higher country of western China, but Dr. Walter Granger secured a number during three winter sojourns at Wanhsien, eastern Szechwan, that are probably to be identified as of this race. The type specimen came from still farther to the northwest near Lunganfu in northern Szechwan, a locality that must mark nearly the limit of the range in this direction. Possibly it is coëxtensive with the forested area of these regions, and if so, would continue to the extreme border of southern Kansu. To the westward but few specimens have been taken, so that its absence from the many collections that have been made in these areas indicates that it is rare or avoids the higher parts.

The record of two specimens in the collection of the U. S. National Museum (A. B. Howell, 1929, p. 64) from southwest of Omei Shan, is therefore interesting, not only as proving the presence of the species in central Szechwan, but also as an illustration of how easy it may be to overlook even so large an animal in collecting. No doubt future work will discover it in Yunnan, particularly at the lower elevations, for Thomas has recorded the species, as *M. edwardsi*, from the Kachin Hills, Burma.

Satunin, in his original description, compares his animal to *M. bowersii*, unaware apparently of its affinity to *M. edwardsi* described twenty years earlier.

Dr. Granger reports that the twelve specimens taken by him all came from steep rocky hillsides with dense growth of thorny bushes and a few small conifers. One specimen was brought in by a native who said that he had taken it from a low tree where it was engaged in a fight with a squirrel.

Specimens examined.—Twelve, from Wanhsien, Szechwan.

444. *Rattus bowersii bowersii* (Anderson)

BOWERS'S RAT

Mus bowersii Anderson, Anat. and Zool. Researches Western Yunnan, p. 304, pl. 17, 1879.

Epimys bowersi Thomas, Journ. Bombay Nat. Hist. Soc., vol. 24, p. 410, 1916.

Rattus bowersi Kloss, Records Indian Mus., vol. 13, p. 5, 1917.

Rattus mackenziei G. M. Allen, Amer. Mus. Novitates, no. 217, p. 15, 1926 (not of Thomas?).

Type specimen.—The type is an adult female preserved in alcohol in the

Indian Museum, Calcutta, from Hotha in the Kakhyen Hills, Yunnan, China, where it was collected by Dr. John Anderson, probably in 1868. Kloss (1917), who has examined the specimen, notes that the color has changed considerably due to long immersion in spirit, and that the skull, as removed from the specimen, is somewhat broken.

Description.—A large species, hind foot about 55 mm., tail longer than head and body or of nearly equal length. General color above from muzzle to root of tail, the upper sides of the arms to the wrists, and on the hind leg to the ankle all around, a dark chocolate brown, minutely ticked on the flanks with white, giving a very faintly grizzled effect. The hairs of the dorsal pelage are of two sorts: shorter and very fine under hairs of a drabby or whitish color, and longer, coarser hairs, either all chocolate brown in color with dull whitish bases, or with minute whitish tips above the terminal half of chocolate. These minute white tips are scattered and give the grizzled effect. The end of the muzzle and area in front of the eye may be darker, almost black. Ears large and thin, their substance blackish brown, clothed with minute blackish or blackish-brown hairs. Central area of the fore and hind feet dusky, the toes and more or less of the sides of the feet white or whitish. Tail blackish all around or with the hairs of the lower side paler, or the extreme tip of the tail may be entirely white. Lower surfaces of the body from chin to vent, the fore limbs to and including the wrist, but on the inside of the hind limbs to just above the ankle, pure white to the bases of the hairs, with the line of demarcation sharply defined from the sides of the muzzle back along the sides of the neck and flanks.

The skull is rather characteristic in its peculiarly straight upper profile from the tip of the nasals back to the level of the eye, where there is a distinct though slight depression, succeeded by a slight upward convexity over the brain case. The posterior angle of the zygomata is more marked than in the similarly large *R. e. edwardsi*, but the postorbital ridges are less strong, and fade nearly out behind the first half of the parietal border. The teeth are as described farther on for the eastern race, *R. bowersii latouchei*, from which typical *R. b. bowersii* differs in the longer nasals, ending nearly square across posteriorly and usually exceeding the premaxillaries in backward extension.

The few available specimens are not fully grown, but were measured as follows by the collector, and I have added the dimensions of the type as given by Anderson (1879):

No.	Head and body	Tail	Hind foot	Ear	Locality
43303	180	192	51	28	Yunnan
43304	210	208	52	30	Yunnan
43305	204	210	55	33	Yunnan
(type)	230	256	55	29	Yunnan

The tail length is seen to vary somewhat in its proportion to total length, from 49 to 52 per cent.

For cranial measurements, see the following table.

CRANIAL MEASUREMENTS OF *RATTUS BOWERSII*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
<i>R. bowersii bowersii</i>									
APUD KLOSS (type)	54.0	44.7	25.2	21.3	—	—	8.7	—	Yunnan
43303	45.0	40.0	25.0	22.0	17.5	—	8.3	8.6	Yunnan
43304	51.0	45.2	27.5	25.0	20.0	—	8.5	8.7	Yunnan
43305	48.6	42.5	26.0	23.8	18.3	—	8.5	8.6	Yunnan
<i>R. bowersii latouchei</i>									
97.6.6.2 BM (type)	56.6	50.2	29.3	27.4	22.3	11.1	9.7	10.0	Fukien
8.8.11.68 BM	56.6	51.4	30.3	27.0	21.5	11.5	9.7	9.3	Fukien
5.6.1.9 BM	55.7	49.3	29.4	26.0	21.6	11.5	9.6	9.4	Fukien
0.5.8.22 BM	55.5	49.3	28.9	25.0	21.7	10.9	10.0	9.6	Fukien
84643	59.0	50.0	29.7	26.0	21.4	12.0	11.3	11.0	Fukien

Occurrence and Habits:—This large rat at first sight resembles *R. edwardsi* but differs in its dark chocolate-brown color, minutely ticked with whitish, as well as in the shape of the skull and in the peculiar backward prolongation of the inner cusp of the two anterior crests of the first upper molar and the middle



FIG. 53. Distribution Map.

- Rattus*
 1. *R. bowersii bowersii*
 2. *R. bowersii latouchei*

- Chiropodomys*
 3. *C. glioides*

- Hapalomyys*
 4. *H. delacouri marmosa*

crest of the second molar. Anderson, in his colored plate as well as in his description, represents the color of the belly and the white of the feet and tail as distinctly yellow, but this was possibly a result of the preserving fluid in which the specimen still is, or may be an individual variation. The white of the lower side may or may not include the upper lip, narrowly, or may even extend to the base of the vibrissæ. In my previous record (1926) of this species as *R. mackenziei*, I compared the three specimens with Thomas's description of the latter from Kindat, Chin Hills, Burma, and believed it to be the same. Now, however, Osgood (1932) has shown in his study of the series in the British Museum that *R. bowersii bowersii* is only subspecifically related to *R. b. latouchei*, and that other described "species" from southeastern Asia are barely recognizable races of the former. Although I have not examined the original specimen of Thomas's *R. mackenziei*, it seems very doubtful to me if this is more than an immature example of *R. b. bowersii*.

The range of this dark-colored, white-bellied rat is largely in Indo-China and the adjoining parts of Burma, extending into extreme southwestern Yunnan, where in addition to the original type specimen from Hotha, the only other records seem to be of those taken by Dr. R. C. Andrews—two from Mucheng on the Salween drainage, 7,000 feet, and one from the Homushu Pass, 9,000 feet.

Nothing is recorded of the habits, but this is evidently a forest-living species.

Specimens examined:—The following three:

Yunnan: Mucheng, Salween drainage, 2; Homushu Pass, 1.

445. *Rattus bowersii latouchei* (Thomas)

LA TOUCHE'S GIANT RAT

Mus latouchei Thomas, Ann. Mag. Nat. Hist., ser. 6, vol. 20, p. 113, 1897.

Rattus latouchei Cabrera, Bol. Real Soc. Esp. Hist. Nat., Madrid, vol. 22, p. 168, 1922.

Rattus bowersii latouchei Osgood, Publ. Field Mus. Nat. Hist., zool. ser., vol. 18, p. 311, 1932.

Type specimen:—An adult female, skin and skull, No. 97.6.6.2, British Museum, from Kuatun, northwestern Fukien, China. Collected by J. D. La Touche.

Description:—A large rat the size of *R. edwardsi* but with a rather different style of coloring. The entire upper parts of the body from the muzzle to the root of the tail and the limbs to the wrist and ankle, a nearly uniform mixture of dark brown or blackish hairs mixed with others having the terminal two-thirds or so similar, but with short white tips. The bases of the hairs are everywhere whitish instead of the usual dark gray. The general effect is therefore of a dull-brown rat, minutely grizzled or dusted with whitish. Hands and

wrists all around white. Hind feet dusky all around just at the ankle and at the basal half of the central metatarsals; the remainder of the foot white. Ears large and thin, their substance brownish, sparsely clad with minute brownish and gray hairs. The lower surface of the chin, throat, body and limbs to the wrist, and almost to the ankle, pure white to the bases of the hairs. The coat in general is soft but a trifle harsh, and consists, as seen with a lens, of hairs of at least three degrees of stiffness. The tail is dark all around, the minute hairs of the lower side, however, partly pale gray, giving a slightly less dark effect.

According to Thomas, the skull is very similar to that of typical *R. b. bowersii*, but differs in having the nasals square-ended behind instead of bowed backward, and in having the posterior nares wider and more open. The nasals are slightly exceeded by the premaxillaries in backward extent. In profile the skull has a very flat outline from the postorbital region to the tip of the nasals, rising very slightly from the orbits back to the center of the parietals and then falling again. The outline of the interparietal is nearly lozenge- or diamond-shaped, with a median point anteriorly and posteriorly and nearly straight outlines to the tips of the bone. The incisive foramina are longer and narrower than in *R. e. edwardsi*, extending back to the level of the anterior molar root. The zygomatic arch has a pronounced angle or elbow posteriorly, adding to "the essentially triangular appearance" of the skull. The supraorbital ridge is not very heavy, and but faintly marked back from the anterior corners of the parietals.

A peculiarity of the upper molars is the backward continuation of the innermost cusp of the cross-rows in the first and second rows of the first molar and the middle one in the second. The posterior molar shows three lobes on the inner side. The incisors are pale, nearly white, faintly tinged with yellow.

Measurements.—The tail more nearly equals the head and body length in this species than in the giant rat, *R. e. edwardsi*. The following dimensions were taken by the collector:

No.	Head and body	Tail	Hind foot	Ear	Locality
84610 imm.	233	245	51	32	Fukien
84621	250	250	—	30	Fukien
84640	250	240	—	30	Fukien
84643	254	170 (!)	58	36	Fukien

For cranial measurements, see table under *R. b. bowersii*.

Occurrence and Habits.—This large rat is about the size and general appearance of *R. edwardsi*, but is not at all closely related, as shown by the peculiarities of the skull. The color is distinctive, a nearly uniform brown, minutely grizzled with white-tipped hairs, while the bases of all the hairs are pale whitish.

It was apparently first discovered by Père Armand David, who sent a specimen to the Paris Museum in 1874 (see Thomas, 1898), but its identity was not made known until nearly a quarter of a century later when Thomas described specimens from Kuatun, northwestern Fukien, in the British Museum. He recognized the close relationship of his animal to *R. bowersii* of Yunnan and Burma, but it has remained for Osgood (1932) to relegate it to subspecific rank as a paler race of the species. In addition to the Kuatun specimens, others have been taken by the American Museum Asiatic Expeditions at Futsing and Yenping, Fukien. Mell (1922) found it sparingly in the mountain forests of northwestern Kwangtung, whence he mentions specimens from Lienping and "Yuyüner Yiu." La Touche also regarded it as a forest rat. No doubt the distribution differs a little from that of *R. edwardsi*, being in general more southern, and probably including the warmer parts of the southern provinces, for there are no records for Szechwan or the provinces adjoining on the east. Nothing is known of the habits.

Specimens examined.—The following thirteen:

Fukien: Kuatun, 4, including the type (B.M.); Futsing, 7; Yenping, 1; no locality, 1.

Genus *Bandicota* Gray

Bandicota Gray, Ann. Mag. Nat. Hist., ser. 4, vol. 12, p. 418, 1873.

The bandicoot rats are large, stoutly built species of a dark blackish-brown color, and with nearly naked, scaly tails. They are ground living, with large broad feet having six plantar pads, of which the one nearest the heel is elongate. The toes, except the thumbs of the fore feet, are provided with strong, nearly straight claws for use in digging. The upper incisors are strong and broad with minute irregular longitudinal wrinkles. The molars represent a high degree of specialization, for the cross-ridges characteristic of the family here no longer show the three tubercle-like cusps of which each is typically formed, but instead the cusps lose more or less completely their separate identity and the cross-ridges become transverse laminæ of enamel, with their median outline bowed strongly forward. Three such ridges are present in the first upper molar, and but two on each of the two succeeding ones. In the two latter, however, the inner cusp of the original first cross-ridge is enlarged and joins with the inner end of the next (complete) cross-ridge, giving it a forked outline. The posterior molar, with slight wear, assumes the appearance of a crescentic ridge of enamel nearly encircling the small round tubercle constituting the second cross-ridge. The lower molars have the cross-ridges laminar, with a faint trace of the original double cusps. There are three of these ridges in the first molar and two in each of the two others. The mammae are twelve in number, three pairs pectoral and three abdominal.

The genus comprises several species of tropical distribution in India and southeastern Asia, one of which just reaches the extreme southwestern border of Yunnan. The type of the genus is *B. gigantea*, the *Mus giganteus* of Hardwicke, from southeastern India.

446. *Bandicota nemorivaga* (Hodgson)

SMALLER BANDICOOT RAT

Mus (Rattus) nemorivagus Hodgson, Journ. Asiatic Soc. Bengal, vol. 5, p. 234, 1836.

Mus (Nesokia) nemorivagus Thomas, Proc. Zool. Soc. London, 1881, p. 529.

Nesocia nemorivaga Blanford, Fauna British India, Mammalia, p. 426, 1891.

Bandicota nemorivaga Wroughton, Journ. Bombay Nat. Hist. Soc., vol. 26, p. 786, 1919.

Type specimen.—The type came from the central region of Nepal, and, although not distinguished in the original description, is perhaps included in the Hodgson collection in the British Museum.

Description.—A large species attaining a length of eighteen inches or over, hind foot about 45 mm. Above, dark blackish brown, the basal half of the fur ashy gray; the tips of the hairs are either black or pale brown, mixed. Feet dark brown above, fingers paler. Lower side paler, described as "whitey brown" or "hoary blue." Longer hairs of the back abundant but not rigid.

Measurements.—The tail is shorter than the head and body, nearly naked and scaly. Blanford gives the following dimensions, reduced to millimeters: head and body, 305 mm.; tail, 240; hind foot, 45; ear, 33. Osgood (1932) records an unusually large specimen from the northern part of Tongking, Indo-China, that measured: total length, 552 mm.; tail, 258; hind foot, 55. Skull length, 52.5 mm.; zygomatic width, 28.7.

Occurrence and Habits.—So far as present knowledge goes, this large rat just reaches the borders of extreme southwestern China, and is another of the species that adds a tinge of the tropical to the Chinese fauna. The only record at present is of specimens taken at Tengyueh in extreme southwestern Yunnan, as mentioned by Wroughton (Journ. Bombay Nat. Hist. Soc., vol. 26, p. 786, 1919) and by Osgood (1932).

Specimens examined.—None.

Genus *Vandeleuria* Gray

Vandeleuria Gray, Ann. Mag. Nat. Hist., ser. 1, vol. 10, p. 265, 1842 (as a genus). Hodgson, Ann. Mag. Nat. Hist., ser. 1, vol. 15, p. 268, 1845 (as a subgenus).

Mus Bennett, Proc. Zool. Soc. London, 1832, p. 121 (in part). Hodgson, Ann. Mag. Nat. Hist., ser. 1, vol. 15, p. 268, 1845 (in part); and other earlier authors.

This genus includes a few species and races of small climbing mice in which the tail is very long, considerably exceeding the length of head and body, with-

out elongate terminal hairs, and in which the feet are adapted for climbing and grasping by the opposability of the first digit on both hand and foot, the possession of a flat nail by these digits instead of a claw, as well as by the presence of a nail on the fifth digit, the shortness of the foot and the prominence of the terminal pads of the digits. In these respects it resembles *Chiropodomys*, but is of more mouse-like proportions and the molar teeth do not show the deep longitudinal grooves of the latter. The upper incisors are slightly grooved vertically. The molars are essentially as in *Rattus* but smaller. The first upper molar has the usual three cross-ridges, consisting each of three tubercular cusps, with a postero-external accessory cusp. The second upper molar has lost the median cusp of the first cross-ridge, but the small inner and outer cusps are present. The tooth has in addition two cross-ridges, corresponding to the second and third, both with their inner and outer cusps, although the inner cusp of the second ridge is very small. The third molar is small and still further reduced, but with practically the same elements as in *Rattus*. The lower molars do not differ essentially from those of the latter except in size, consisting of the usual paired cusps, three pairs on the first and two each on the second and third molars. Anderson (1879) pointed out that the posterior nares (interpterygoid fossa) are wide, though less so than in *Chiropodomys*, being less than half the length of the incisive foramina; the anterior edge of the zygomatic plate is vertical instead of being slightly concave in side view, while the parapterygoid fossæ are wide, shallow, and perforated by several small openings. The genus does not therefore depart very widely from the smaller rats, except in the scansorial nature of the feet and in the grooving of the upper incisors. There are two pectoral and two abdominal pairs of mammæ, or eight in all.

Up to within recent years it has been customary to recognize but a single Indian species of this genus, *V. oleracea*, the genotype, a small mouse with a white belly and ochraceous-buff upper side. It now appears, however, that the species long ago described from the central region of Nepal by Hodgson as *M. (V.) dumeticola* is distinct and that its range extends to the southwestern borders of Yunnan. The animal I described in 1927 as *Chiropodomys fulvus* is apparently a member of the genus *Vandeleuria*.

447. *Vandeleuria dumeticola* (Hodgson)

LONG-TAILED CLIMBING MOUSE

Mus (Vandeleuria) dumeticola Hodgson, Ann. Mag. Nat. Hist., ser. I, vol. 15, p. 268, 1845.

Chiropodomys fulvus G. M. Allen, Amer. Mus. Novitates, no. 270, p. 11, 1927. Yinpankai, Yunnan.

Type specimen.—The original specimen was from the "central region of Nepal," where it was collected by B. H. Hodgson, and is now presumably in the British Museum.

Description.—Pelage full and almost silky. Entire dorsal surfaces, except the ears and tail, but including the backs of the fore and hind feet, fulvous, very slightly darkened over the lower part of the back by scattered fine black hairs. Cheeks and flanks clear bright fulvous. Forehead and occiput slightly darkened and grayer than the back. Ears sparsely covered with short hairs, fulvous on the inner surface, but on the proëctote contrastingly blackish. Under surfaces from chin to anus, the forearms and the inside of the hind limbs to near the ankle, white, not very sharply marked off at the sides. The chin and throat as well as the under side of the forearms are white to the roots of the hairs, but elsewhere the hairs are slaty in their basal half. A small median spot of fulvous is present on the chest. A few hairs at the tips of the toes are silvery white. Tail sparsely haired, with a slight terminal pencil, its color uniformly dusky except on the basal half below which is buffy. Vibrissæ long and black, reaching to the ends of the ears as folded back.

The skull is characterized by its short rostrum, with practically no antorbital notch, and with the anterior edge of the zygomatic plate very slightly concave. Brain case broad and slightly flattened, nasals extending back to the level of the zygomata, but exceeded in backward extent by the premaxillaries. Beginning at about the anterior third of the nasals and going back to the front of the parietals is a shallow depression or groove bounded in the interorbital region by a rounded ridge at either side of the frontals. In ventral view the incisive foramina just reach the level of the first molars.

Measurements.—The measurements of the specimen from Yinpankai I described as *Chiropodomys fulvus* are: head and body, 75 mm.; tail, 133; hind foot, 18.5; ear, 17.

The cranial measurements of this specimen are: greatest length, 22.3 mm.; basal length, 18.5; palatal length, 10.6; length of nasals, 6.7; zygomatic width, 11.7; mastoid width, 9.5; upper cheek teeth, 3.3; lower cheek teeth, 3.8.

Occurrence and Habits.—This seems to be an uncommon species in extreme southwestern Yunnan. At all events, Dr. R. C. Andrews and Edmund Heller, in the course of their collecting in this province, secured but a single specimen at Yinpankai, Mekong River, at an altitude of 9,000 feet, in 1916, while other recent collectors in the region have missed it altogether.

Specimens examined.—One only, from Yinpankai, Yunnan.

448. *Vandeleuria oleracea* (Bennett)

Mus oleraceus Bennett, Proc. Zool. Soc. London, 1832, p. 121.

Mus (Vandeleuria) oleraceus Anderson, Anat. and Zool. Researches Western Yunnan, p. 313, 1879.

Vandeleuria oleracea A. B. Howell, Proc. U. S. Nat. Mus., vol. 75, art. 1, p. 66, 1929.

Type specimen.—The type specimen was sent by Sykes from the Deccan

(Dukhun) Peninsula, India, to the British Museum where it presumably still is.

Description.—A small, delicately formed mouse, with a tail half again as long as the head and body. The upper surface "is rich rufous, or chestnut red, paling to brown on the ears and on the muzzle before the eyes; the sides of the face below the eyes and moustachial area, the chin, throat, and under parts generally are white, with a yellowish tinge. The feet pale-brown, passing almost into white on the toes. . . . The tail brownish or dusky; the hairs grayish" (Anderson).

Measurements.—The unusually long tail in proportion to the head and body is the striking feature. Anderson gives the measurements of a specimen from the Burma border of Yunnan at Nampoung, as follows: tip of muzzle to vent, 2.43 inches (62 mm.); tail, 4.35 inches (110 mm.); hind foot, 0.70 inches (18 mm.); ear, 0.53 inches (14 mm.).

The cranial measurements of the same specimen, reduced to millimeters, are: upper border of foramen magnum to tip of premaxillæ, 21 mm.; middle of zygomatic plate to tip of premaxillaries, 5.0; interorbital width, 3.9; zygomatic width, 13; palatal length, 11; upper cheek teeth, 3.5.

Occurrence and Habits.—Anderson gives a detailed account of a specimen secured during his expedition to Yunnan, "in the valley of the Nampoung, a frontier stream dividing Burma from China." The only record of the species within Chinese territory, however, is apparently that of A. B. Howell (1929), who records one in the U. S. National Museum from Yangchiaoshan, Yunnan. It was caught alive in a nest of grass situated in a bush.

Specimens examined.—None.

Genus *Chiropodomys* Peters

Chiropodomys Peters, Monatsb. Kön. Preuss. Akad. Wiss. Berlin, 1868, p. 448.

Mus (in part), of earlier authors.

The small climbing mice of this genus are adapted for arboreal habits in a number of particulars. The ears are relatively large and thin, nearly naked, the vibrissæ long, the tail longer than head and body, its numerous hairs becoming longer in the terminal half to form a slight pencil at the tail-tip. The feet are short and spreading, with a stumpy first digit, thumb-like, and provided with a flattened nail instead of a claw in both fore and hind feet. The other digits have short, slightly curved claws which very little exceed the large terminal pads of the toes. The sole of the hind foot is naked, with a long narrow tarsal pad on the outer half and a shorter oval one in the middle of the inner side. There are four well-developed pads under the toes. In the only

female specimen seen, the mammae are four, abdominal, in two pairs. As in many arboreal mammals, the muzzle is short and the upper profile of the skull convex upward, with a decided downward curve to the occiput. From above, the skull is seen to have a relatively wide interorbital space and broad brain case, with a short bony ridge running along the upper edge from the orbit outward and backward following the outer frontoparietal border back to the notch of the latter bone. The distance from the front edge of the zygoma to tip of rostrum equals the diastema between the incisors and molar row. In ventral view the incisive foramina are wide and short, ending on a level with the front of the first molars. The posterior edge of the palate is level with the hind edge of the last molar and has a short median projection. The molar teeth are peculiar and characteristic. Although with the same fundamental arrangement of cusps as in *Rattus*, the central series is high and forms a median longitudinal ridge in the two anterior teeth, with a deep groove or valley on each side separating this ridge from the border series of cusps which form lower ridges on the inner and outer edges of these teeth. The last upper molar has lost the outer series of cusps, and consists only of the large median cusp and the inner series, so that the single longitudinal groove of this tooth is formed between the two inner ridges only, and the tooth appears as if set in from the outer edge of the tooth row. For additional details see the account of the species following. The whole appearance of the animal is very much that of a small dormouse.

So far as known, this tree mouse is confined to the forested parts of southeastern Asia, from southern China to Tenasserim and Indo-China south to Borneo, Sumatra, and Java. On the continent it seems to be represented by a single species, the type of the genus, *C. gliroides*, of which the island forms are probably best regarded as subspecies. The animal that I previously described (G. M. Allen, 1927, p. 11) as *Chiropodomys fulvus* proves on further study to be a *Vandeleuria*.

449. *Chiropodomys gliroides* (Blyth)

PENCIL-TAILED TREE MOUSE

Mus gliroides Blyth, Journ. Asiatic Soc. Bengal, vol. 24, p. 721, 1855.

Chiropodomys gliroides Thomas, Proc. Zool. Soc. London, 1886, p. 78. Osgood, Publ. Field Mus. Nat. Hist., zool. ser., vol. 18, p. 319, 1932.

Hapalomys pasquieri Shih, Bull. Dept. Biol., Sun Yatsen Univ., Canton, no. 4, p. 9, 1930 (not of Thomas).

Type specimen.—The type was from Cherra Punji, Khasi Hills, Assam, India, and was presumably preserved in the Indian Museum, Calcutta, where, according to Thomas (1891b), it cannot now be traced.

Description.—Central part of the forehead from muzzle to occiput, grayish tawny, the central portion of the back the same but darker, the result of a mixture of hairs with a pale ochraceous tip and evenly scattered blackish-brown hairs. On the cheeks below the eye and ear, the sides of the neck and

flanks, and across the shoulders, the tint is brighter and more decidedly pale ochraceous with very little admixture of darker hair. The general color of the back is therefore a grayish tawny, becoming clearer and brighter buffy on the shoulders and sides. Ears and tail with their skin dark brownish and the minute hairs of the former of similar color. The tail is thickly covered above and below with short brown hairs which, however, do not altogether obscure the scaling; in its terminal half these stiff hairs increase in length, forming a slight pencil at the end. A very narrow black line surrounds the eye. Vibrissæ black. The backs of the feet are sparsely covered with short, buffy-white hairs. Upper lip from muzzle to just below the eyes, broadly white, as well as the rest of the under side of the chin, throat, chest and abdomen to the base of the tail, the fore limbs to and including the wrists, and on the inner side of the hind limbs to just below the knee, beyond which the lower tibial region becomes grayish.

The essential characters of the skull have been mentioned under the generic description. The short rostrum and the arched brain case, convex upward and slightly decurved in the occipital region, are somewhat distinctive of arboreal as contrasted with terrestrial rodents. The upper molar teeth are especially noteworthy for the prominence of the central ridge of the two anterior teeth, with a broad, deep valley separating it on each side from the lateral ridges of cusps to form two grooves, continuous from one tooth to the other, and the inner groove continued the length of the third molar, which, however, lacks the outer valley and external ridge of cusps, so that this tooth is noticeably narrower than the one in front of it. The first upper molar has the three cross-ridges all about equally developed, each with a central larger cusp and an outer and an inner smaller one, well marked, of about the same size. With slight wear the anterior outline of the ridge is a broad W, with the central apex rounded and slightly in advance of the lateral ones. The second molar has the second and third cross-crests fully developed, the latter with the lateral cusps narrower than those of the second, while the first crest lacks the central cusp, has a minute remnant of the outer and a nearly full-sized inner cusp. The third molar is the smallest, with about a third the crown area of the second, and lacks all the three outer cusps of the cross-ridges. The first ridge is represented by only the innermost of the three original cusps; the second ridge consists of the central and the inner of the three; and the third ridge is represented by the inner one only, so that the tooth has three rounded tubercles on its inner margin and one on its outer. The first lower molar consists of three pairs of cusps, with a deep groove between them longitudinally and a very narrow external ledge. The second molar has two pairs of cusps and a minute antero-external tubercle, while the third molar is similar to the second but smaller and lacks the postero-external cusp of the hinder cross-ridge.

Measurements:—The field measurements of a specimen from Tongking, Indo-China, are: total length, 193 mm.; tail, 110; hind foot, 18.

CRANIAL MEASUREMENTS OF *CHIROPODOMYS GLIROIDES*

No.	Greatest length	Basal length	Palatal length	Zygomastic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
27105 MCZ	24.6	21.3	12.6	12.7	11.0	5.4	3.7	3.8	Kwangsi
27058 MCZ	24.1	21.7	12.5	12.6	10.7	5.4	3.6	3.7	Tongking

Occurrence and Habits:—This is a tropical species of southeastern Asia, extending northward into the extreme southern portions of China, and has not hitherto been reported from that country. Through the kindness of Mr. Chausu M. Shih, however, the Museum of Comparative Zoölogy has secured one of the eleven specimens recorded by him as *Hapalomys pasquieri*, from Yao Shan, Kwangsi, and it proves to be instead a *Chiropodomys* of this species, a not unnatural mistake. The series was secured in the course of collecting at Kutchen and Loshiang, and adds this interesting genus to the list of subtropical mammals that reach the southern parts of eastern China. Osgood (1932) has recorded a small series taken by the Field Museum expedition in northern Tongking, Indo-China, one of which is also in the Museum of Comparative Zoölogy. It is to be looked for in extreme southwestern Yunnan, for Thomas (1891b) has recorded it from the Kakhyen Hills, Burma, on the very border of that province. Nothing is known of the habits.

Specimens examined:—One Chinese specimen only, from Yao Shan, Kwangsi (M. C. Z.).

Genus *Hapalomys* Blyth

Hapalomys Blyth, Journ. Asiatic Soc. Bengal, vol. 28, p. 296, 1859. Slater, Proc. Zool. Soc. London, 1890, p. 534, pl. 45, figs. 7-9, 12.

The type species, *H. longicaudatus*, from the valley of the Sitang River, Burma, remained for a long time the only one known, and specimens even of that are still few in the museums of the world. In 1927, however, Thomas described two others from Indo-China, one of which is doubtless very close to the one I described from Hainan at about the same time.

In external appearance this long-tailed rat is soft-haired, with a tail considerably exceeding the head and body, and sparsely covered with hairs that gradually increase in length in the terminal half or third till they reach about 10-12 mm. The vibrissæ are long, and there is a line of longer tactile hairs on the edge of the ear. The feet are modified for climbing by having enlarged toe-pads consisting of two flat plates with a groove between them, the hind toes long and slender, the middle three subequal, the first with a flattened nail

instead of a claw, but the fifth clawed. The digits of the fore feet are four, each with a very small claw nearly embedded in the toe-pad. According to Sclater, the first digit "forms a slight projection on the inner side of the hand, but has no trace of a nail."

The skull, as usual in climbing species, has a shortened rostrum. The front edge of the antorbital plate is perpendicular, and the palate ends on a level with the back edge of the last molar. The teeth are very distinctive in that the lower molars show a fairly well-developed third series of cusps, so that, as in the upper jaw, the pattern comprises three cross-ridges, consisting of three tubercles each, or of but two where one is lacking. Thus in the first lower molar the antero-external cusp is lacking, so that there are only two in the cross-ridge, while the two following consist of three each. The second lower molar has two cross-ridges each of three cusps, "while the posterior molar consists of four cusps only, representing the two central and two external cusps, with a slight trace of the anterior external cusp." The incisors, especially the lower, are broader than in *Rattus*. The anteriormost upper molar shows three cross-ridges of three cusps each; in the second, two similar cross-ridges. The last upper tooth has two ridges, both of which lack the outermost cusp. The mammae, as in *Chiropodomys*, are reduced, consisting of but two abdominal pairs.

In addition to the species which I described from Hainan and which is probably very similar to *H. delacouri*, Shih has recorded from Kwangtung, *H. delacouri* with a question, and *H. pasquieri*. Through his kindness I have one of the latter before me, and it proves to be a *Chiropodomys gliroides*, a not unnatural mistake, so that without confirmation of the identity, the inclusion of *H. delacouri* may best be provisional.

450. *Hapalomys delacouri marmosa* G. M. Allen

Hapalomys marmosa G. M. Allen, Amer. Mus. Novitates, no. 270, p. 12, 1927.

Type specimen.—An adult female, skin (skull missing), No. 59046, American Museum of Natural History, from near Nodoa, island of Hainan, China. Collected December 27, 1922, by Mr. Clifford H. Pope of the Central Asiatic Expeditions.

Description.—The pelage soft and fine in texture, the longer hairs of the back about 12 mm. in length. General color a nearly uniform dull reddish gray, near cinnamon (Ridgway, 1912), with a slight admixture of scattered black hairs; sides paler. Feet and limbs buffy gray. The entire under surface, including fore legs and the hind legs to below the knee, pure white to the roots of the hairs. Ankles below, and the tail with its short hairs, dusky. The tail is nearly naked, its sparse short hairs hardly longer than the width of a scale-

row except near the tip where they form a slight pencil and are about the length of four scale-rows. Vibrissæ prominent, black, slightly longer than the head. The otherwise nearly naked ears have a fringe of long stiff hairs projecting from the inner surface of the conch and there is a tuft of similar hairs at their anterior base.

The cranial characters await description, but probably are much the same as described by Thomas (Proc. Zool. Soc. London, 1927, p. 56) for *H. delacouri*, which in turn is but a smaller replica of *H. longicaudatus*.

Measurements:—The collector's measurements of the type of this race are: head and body, 130 mm.; tail, 138; hind foot, 21; ear, 12. These are slightly different from those given by Thomas for the type of *H. delacouri* in which the tail is proportionally longer and the ear slightly longer. These apparent differences may well prove, however, to be largely individual.

Unfortunately the skull of the type of *H. marmosa* could not be found, but that of *H. delacouri* is 34.3 mm. in greatest length, with the upper molar series 6 mm.

Occurrence and Habits:—The discovery of this genus on the island of Hainan was one of the interesting results of Mr. Clifford H. Pope's work there in 1922 and antedates by some five years the finding of what is obviously a closely related form on the mainland by Delacour, although by a curious chance both were described at almost the same time in 1927. It may eventually prove that the Hainan animal is not really separable from the Indo-Chinese *H. delacouri* (type locality, Dak-to, Annam), so that in that case the name *marmosa* will become a synonym; on the score of probability, however, it may be retained as a subspecies, awaiting the collection of additional specimens. Only the type from Nodoo, Hainan, is known, and the skull of the specimen is unfortunately missing. Mention may again be made here of Shih's (1930a) record of an adult female referred, with question, to *H. delacouri*, from Loshiang, Yao Shan, Kwangsi, which, if it proves to be valid, will extend the known range of this tropical genus into the extreme southern provinces of the Chinese mainland.

Specimens examined:—One, the type, from Nodoo, Hainan.

SUPERFAMILY DIPODOIDEA

JERBOA-LIKE RODENTS

In Miller and Gidley's classification of the rodents this superfamily includes a rather diverse series of genera, with arboreal, fossorial and saltatorial types, which agree in having the outer layer of the lateral portion of the masseter "attaching along a considerable area on anterior border of zygoma; zygomatic

plate nearly horizontal, always narrow and completely beneath infraorbital foramen. Angular portion of mandible not distorted outward at base, . . . its general direction not parallel with zygoma."

Only two families, as recognized by these authors, occur within the area of China and Mongolia. These are: the Zapodidæ and the Dipodidæ, the former containing two genera of less modified species, the latter several genera adapted for desert life and a more notably saltatorial method of progress. Both groups are probably not distantly related. Their differences are due in part to the greater specializations incident to desert living, such as the greater lengthening of the hind foot, reduction of outer toes, fusion of the central metatarsals, and increased size of audital bullæ in the latter, as contrasted with the simpler conditions in the former which inhabit grasslands or woodlands.

Family ZAPODIDÆ

JUMPING MICE

The species are small, mouse-like animals with relatively long narrow feet. The infraorbital foramen is noticeably large for the passage of both muscle and nerve. The cheek teeth in the more conservative members may be as many as five above and four below, but this number is reduced in the more progressive types to three below and either three or four above. The enamel structure is rather complex, the essential pattern consisting of infoldings of enamel from both sides of the molars. The first large upper molar has four narrow infoldings from the outer side of the tooth, nearly transverse in direction and continued to the inner wall of the tooth, the outer loop of the folds slightly more elevated than elsewhere, to form low tubercles in unworn teeth. On the inner side of this tooth there is a single long fold running diagonally forward from near the middle of the tooth. The second molar is similar, but the inner reëntrant is a mere shallow indentation, while the third upper molar has an even more shallow indentation and but three infoldings from the outer side. Counting from the outer side, there are therefore five, five and four lobes on the outer edge of these upper teeth, the anterior and posteriormost of which are low, like cingulum cusps, so that in the last molar the anteriormost is hardly developed. The lower molars are of similar but reversed structure.

Two subfamilies are represented in Asia. The first, the Sicistinæ, includes only the genus *Sicista*, in which the upper incisors are ungrooved, the upper cheek teeth four, the lower three, and the general form is very mouse-like, without special elongation of tail, legs or feet. The second subfamily, the Zapodinæ, is represented in Asia by the genus *Zapus* (subgenus *Eozapus*) and in North America by the typical *Zapus* and by *Napæozapus*. Both genera have grooved upper incisors, elongated tails, legs and hind feet, but the tooth formula is slightly different in *Napæozapus* which has lost the upper premolar.

Vinogradov (1925) has given the results of his study of the external genitalia of several species of *Sicista* and compared these with the conditions in *Zapus setchuanus*, showing that while in the former the baculum is a slender rod with usually a slightly spatulate tip and considerably convex ventrally, in the latter it is stouter at the base, with a widely diamond-shaped tip as seen from above, and doubly curved, being slightly convex *upward* in side view, then bowing ventrally in the terminal fourth. He would give generic rank to *Eozapus*, but since no comparison was made with American species, and the slight differences otherwise separating this species are of quantitative value only, it does not seem necessary to place it in a separate genus.

Genus *Sicista* Gray

Sicista Gray, in Griffith, Animal Kingdom by Cuvier, vol. 5, p. 228, 1827.

Sminthus Nathusius, in Nordmann, Demidoff's Voy. dans la Russie Mérid., vol. 3, p. 49, 1841-42.

The generic characters are those of the subfamily: small, mouse-like species, with slender but not unusually long hind feet, tails considerably longer than head and body, upper incisors ungrooved, the teeth five above and four below, with the formula: $i. \frac{1}{1} c. \frac{0}{0} pm. \frac{1}{0} m. \frac{3}{3} = 18$, the upper premolar very small and nearly circular in crown view, the last molar very little larger and slightly more oval in section. The enamel pattern of the two larger upper molars consists of a very small anterior and posterior cusp, resulting from slight infoldings of the enamel from the outer side, and two pairs of opposite tubercles due to a deep infolding of enamel from the center of the outer and the inner sides, these infoldings of practically equal depth on opposite borders, giving the teeth a four-cusped appearance. A lower and narrower infolding makes a thin ridge between the two main cusps of the outer side, so that there are really three outer and two inner cusps exclusive of the narrow cingulum-cusps at either end. In the lower anterior two molars the condition is similar but reversed. Mammæ eight, two pairs pectoral and two pairs abdominal.

The type species is the *Mus subtilis* Pallas of western Asia. Although a number of names have been given to members of this group, specimens from the different parts of the range are relatively few in collections, and it is not yet possible to estimate their standing or relationship to one another. There appear, however, to be at least two groups, one of a nearly uniform color above, the other with a narrow black spinal stripe. In parts of northern China, the former type is represented by *S. concolor* of Kansu, but the second also is likely to be found along the northern border of Mongolia, for Thomas in 1912 recorded as *S. betulina* one of this type from the Syansk Mountains, one hundred miles west of Lake Baikal, almost on the frontier, while Radde (1862, p. 171) long previously had recorded four specimens of the same group (as

Sminthus vagus) from birch woods in the vicinity of Tunka, west of Lake Baikal, at the headwaters of the Yenesei River.

451. *Sicista concolor* (Buechner)

Sminthus concolor Buechner, Bull. Acad. Imp. Sci. St. Pétersbourg, vol. 35 (new ser., vol. 3), p. 107, 1892.

Sicista concolor Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 10, p. 401, 1912.

Sicista weigoldi Jacobi, Abh. u. Ber. Mus. f. Tier- u. Völkerk., Dresden, vol. 16, no. 1, p. 15, 1922. "Hsueschan" (Hsueshan), near Sungpan, Szechwan.

Type specimen.—Buechner described this species from a female specimen in spirit, No. 2797, in the Zoological Museum of the Academy of Sciences at Leningrad, from the town of Guiduisha, north slope of the mountains of Sining, Kansu, China. Collected June 28, 1890, by the brothers Grum-Grzimaïlo.

Description.—The type is described as having the entire upper side of the head and body "brownish," the back darker and the sides paler, partly reddish brown, without trace of other marking. The bases of the hairs are everywhere dark gray. Sides of the muzzle and the upper lips whitish. Muzzle densely haired up to the nostrils which are separated by a deep vertical groove. Vibrissæ short, the longest not reaching the tip of the ear. The ear laid forward reaches the anterior edge of the eye. Its outer base is formed by a rounded, fleshy lobe, directed forward. The proëctote is clothed with pale-brown hairs. The color of the upper side passes gradually into the pale brownish of the belly, the gray bases of the hairs showing through. Feet whitish. The tail is described as uniformly colored, thinly clad with short, pale-gray hairs through which the scale-rows are visible. Probably, however, as in other species, the lower side is paler than the upper, although in the type, as Buechner expressly states, the tail is dark throughout.

Measurements.—The type measured: head and body, 71 mm.; tail, 105; hind foot, 18; ear, 13. These dimensions are practically as in *S. flava* of Kashmir, of which *concolor* is probably to be regarded as a subspecies.

The cranial dimensions of the type are: basilar length, 15.5 mm.; inter-orbital constriction, 4; length of nasals, 7.8; upper cheek teeth, crowns, 3.1; diastema, 5.2; posterior lower molar to condyle, 10.7.

Nomenclature.—When this genus is better known, it is likely that *S. concolor* will be found to be closely related to *S. flava* as a subspecies. The status of *S. weigoldi* is less clear. It apparently differs from *S. concolor* in having the tail bicolor, as usual in the other known forms of the genus, so that one may conclude that the dark under side described for the latter is unusual or possibly due to discoloration in alcohol, for in other respects the two are colored alike. The other distinguishing feature is said to be the relatively shorter tail, which nevertheless is 105 mm. or exactly the same as in *S. concolor*, although the head and body measure 85 mm. against 71 mm. in the latter.

These slight differences are best regarded at present as matters of individual variation instead of specific characters, so that *S. weigoldi*, type locality "Hsueschan" (near Sungpan), is here included in the synonymy of *S. concolor*.

Occurrence and Habits.—Individuals of this genus seem difficult to secure, whether on account of peculiar habits or actual scarcity is not known. The few hitherto taken came from southern Kansu and northwestern Szechwan, and include, in addition to the type from Guiduisha on the north slope of the mountains of Sining, Kansu, and the specimen made the type of *S. weigoldi* from Hsueshan near Sungpan, Szechwan, but two others, both females, taken respectively thirty-five and forty-four miles southeast of Taochow, Kansu, at between 9,000 and 10,000 feet altitude (Thomas, 1912d, p. 401). These two specimens are in the British Museum. Little seems to be known of the habits, but other species are known to frequent birch thickets, and the type of *S. weigoldi* was found freshly dead and uninjured in a grass nest (probably a bird's) in a bush. Weigold supposed that many small burrows noticed by him in areas of low scrub near Sungpan were made by this species, but in this he was probably mistaken, for he never could catch their makers. A. B. Howell (1929) records a young specimen too immature for certain identification from near Imienpo, Manchuria, and now in the U. S. National Museum, but this eastward extension of the known range must await confirmation.

Specimens examined.—None.

Genus *Zapus* Coues

Zapus Coues, Bull. U. S. Geol. and Geogr. Surv. Terr., vol. 1 (ser. 2), p. 253, 1875.

In these Jumping Mice the hind legs and feet are relatively more elongated than in *Sicista*, the hind feet considerably exceeding the length of the skull instead of about equaling it. The tail also is proportionally much longer, being from four to six times the length of the hind foot. The fur is slightly hispid, the ears short. The first digit of the fore foot is a short rounded tubercle. The hind foot is long and slender, with a short first digit barely reaching to the base of the fifth, while the three central toes are long, the second and fourth subequal, with the third a trifle the longest. All have small claws. Mammæ usually eight, two pairs pectoral, two abdominal. The skull, as in *Sicista*, shows no special enlargement of the auditory region, but is proportionally rather small, with, however, the characteristic enlargement of the antorbital foramen for the passage of both muscle and nerve, causing the zygomatic plate to be forced out laterally, so that it forms the ventral side of the opening, while the dorsal bridge is narrowed and extended to form the upper and outer boundary. The jugal bone is slender and has a narrow ascending arm forming the posterior portion of this bridge, and extending

upward at a right angle to meet the lachrymal bone. The slender rostrum is elongate so that the ends of the nasals considerably overhang the upper incisors. The latter are orange-colored and have each a deep vertical groove in the center. The tooth formula is: $i.1 \frac{1}{2} c.0 pm.1 \frac{1}{2} m.3 = 18$, as in *Sicista*. The pattern of the upper molars is much less bilaterally symmetrical than in the latter, since the reëtrant folds of enamel from the outer side extend across to the inner wall, and the single main reëtrant of the inner side is much shallower. Otherwise the essential pattern is much the same. The genus, though common across the northern part of North America, is known in Asia from the Chinese highlands only, where it is represented by a single species for which, on account of its slightly more primitive tooth development, a special subgenus *Eozapus* was founded by Preble (1899). It is distinguished chiefly by the molar pattern in which the inner reëtrants of the upper molars are much shallower and more nearly transverse, that of the first molar alone deep enough to cut off a lobe on the lingual side, while in typical *Zapus* of North America the reëtrant fold is almost longitudinal and is deep in both anterior molars.

The single Chinese species and its northern race are distinguished by the latter having a pure white belly, while the southern race has a median line of buffy on the belly.

452. *Zapus (Eozapus) setchuanus* Pousargues

Zapus setchuanus Pousargues, Ann. des Sci. Nat., Zool., ser. 8, vol. 1, p. 220, April, 1896; Bull. Mus. d'Hist. Nat., Paris, vol. 2, p. 13, figs. 1-3, 1896.

Zapus (Eozapus) setchuanus Preble, North Amer. Fauna, no. 15, p. 37, figs. 3, 4, 1899 (new subgenus).

Eozapus setchuanus Vinogradov, Proc. Zool. Soc. London, 1925, p. 577, pl. 4, fig. 6, pl. 5, fig. 6.

Type specimens.—The species was described from three specimens, originally preserved in alcohol but subsequently skinned out and the skulls separately kept, but since no one is specified as the type, all are cotypes. These were sent to the Muséum d'Histoire Naturelle at Paris from Tatsienlu, western Szechwan (now Hsikang), China, where they were collected about 1895 by the French missionaries stationed there. The skulls are all imperfect, that of the largest "so badly crushed as to be almost worthless."

Description.—Preble, who examined the types, described the color as "tawny ochraceous" above, with a darker and sharply defined dorsal area from the forehead to the tail and spreading out into a broad saddle over the back in which the black hairs are more numerous than the ochraceous, giving the appearance of an olive-brown area flecked with ochraceous, while the sides, from the muzzle to the rump, including the upper sides of the fore and hind limbs, are nearly clear tawny ochraceous with few and regularly scattered black hairs. A median stripe of tawny about 5 mm. wide extends down the entire length of the chest and belly, but elsewhere the under side, including the chin,

chest, belly, lower surface of the fore and hind legs, and the upper side of the feet, as well as a broad edging of the upper lip, are white to the roots of the hairs. The long tail is thinly haired, dusky above and pure white below and at the extreme tip all around, including the scales which show through. The exposed portions of the ears are brownish black with a few scattered hairs of ochraceous.

The skull is remarkably like that of the American *Z. hudsonius*, but in the specimen at hand with a slightly narrower rostrum (Preble says broader), larger bullæ, and with the palate longer, its posterior edge on a level with the back of the last molar instead of extending only to the middle of that tooth. The interpterygoid fossa is narrower and slightly constricted by the inward bowing hamular processes. The incisive foramina are short and slightly narrower than in typical *Zapus*. The small upper premolar is nearly circular in crown view, with a distinct groove on its anterior face, and indication of a transverse furrow in the middle, dividing the crown into four minute and sub-equal cusps. The first upper molar is slightly larger than the second, with a short infolding of the enamel from the anterior third of the inner side to form a narrow antero-internal lobe extending forward less than half-way across the tooth; on the outer side of the tooth there are five such lobes, narrow and nearly transverse, of which the second and fourth are vertically the highest, while the others are much lower. The second upper molar is similar, except that the infolding of the enamel wall on the lingual side of the tooth is a mere indentation, not sufficient to mark off a lobe. The third upper molar is about three-fourths the size of the second, with a faint indication of the inner groove and with but four instead of five external lobes. The three lower molars have each four well-marked enamel lobes on the inner side. The large anteriormost tooth has a vertical infold on its front border and two backwardly extending infolds on the outer side, while the two succeeding teeth have each but a single such infold on the outer side. An excellent figure of the tooth pattern of a cotype is given by Preble (1899, p. 37).

Measurements:—The three cotypes from Tatsienlu were an old adult, an adult, and an immature, the measurements of which were published by Pou-sargues as follows, and in the same order: head and body, 100, 80, 70 mm.; tail, 120, 103, 95; hind foot, 31, 30, 28. The ratio of tail to total length in the three specimens is, respectively, 54, 55, and 57 per cent. Preble (1899) has published the following cranial measurements for the second and third of these specimens, respectively: zygomatic width, 11.6, 11.5; interorbital constriction, 3.6, 3.8; fronto-palatal depth at middle of molar series, 5.5, 5.6.

Occurrence and Habits:—The discovery of a member of this genus in the Chinese highlands is in line with many other facts in the distribution of Asiatic

and North American species, and is evidence of a once more extensive range that has since become restricted by unfavorable conditions. In North America the jumping mice are usually very easily trapped, but in China very few specimens have yet been secured, which may indicate a local distribution in particular types of habitat not usually explored by the few trained collectors who have visited these regions. At all events, few further specimens of this typical subspecies have been taken since the original three sent home by the enlightened French missionaries from Tatsienlu, western Szechwan (now Hsikang). This locality is alpine, the town itself standing at an altitude of

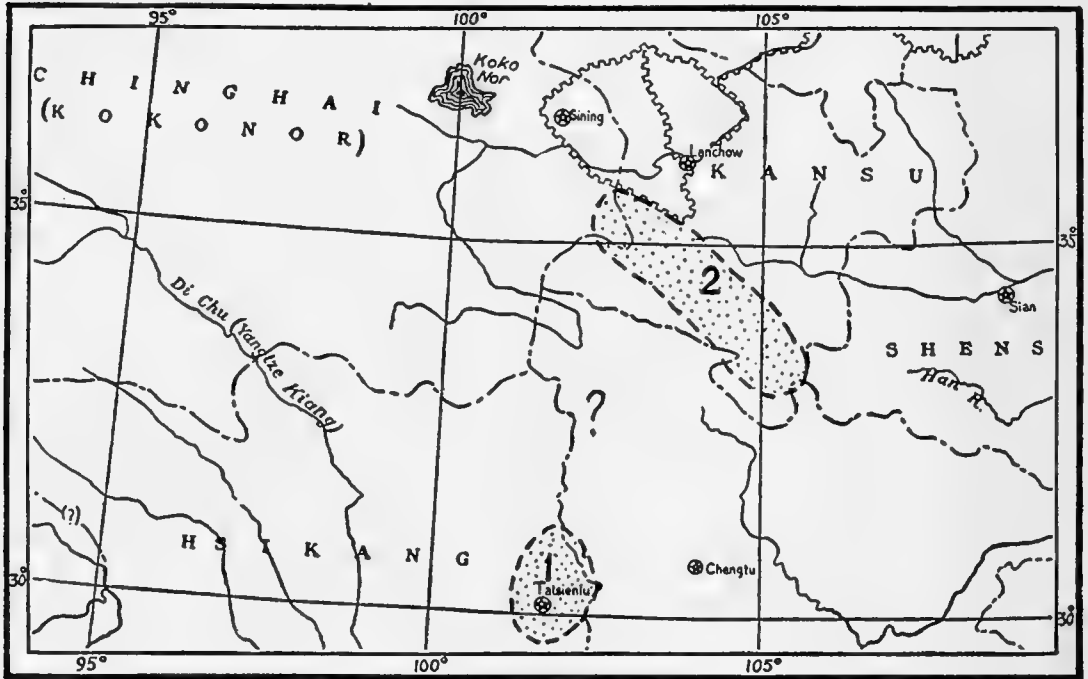


FIG. 54. Distribution Map.
Zapus

1. *Z. (Eozapus) setchuanus*

2. *Z. (Eozapus) setchuanus vicinus*

some 12,000 feet and with alpine peaks nearby extending up to 25,000 feet and over. The only additional record I can add is of one taken by the Brooke Dolan Expedition of 1934-36, in the Anya valley, four days' travel west-southwest of Tatsienlu, and now in the collection of the Academy of Natural Sciences, Philadelphia (G. M. Allen, 1939). The high altitude is in keeping with the northern habitat of the genus in America.

Vinogradov (1925), in his paper on the genitalia, mentions "material" of this species in the collection of the Museum of the Academy of Sciences at Leningrad, but does not state whence it came.

Specimens examined:—One, Anya valley, Szechwan (A.N.S.P.).

453. *Zapus (Eozapus) setchuanus vicinus* Thomas

Zapus setchuanus vicinus Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 10, p. 402, 1912.

Type specimen.—An adult female, skin and skull, No. 12.8.5.62, British Museum, from forty-six miles southeast of Taochow, Kansu, China, altitude 9,800-10,000 feet. Collected September 22, 1911, by G. Fenwick Owen.

Description.—Similar in general to the typical race from Tatsienlu but belly entirely white, lacking the broad median buffy line. The tail is apparently longer also. In its dorsal coloring this race is the same as described for the typical form, with the blackish and ochraceous saddle, nape and forehead, and brighter, nearly clear ochraceous-tawny sides, cheeks and upper sides of limbs, a coloring very similar to that of the American *Napæozapus* though not quite so bright, and much brighter than the duller ochraceous olive of *Z. hudsonius*. Upper lips and entire under side of the body pure white to the roots of the hairs. Tail sharply bicolor, blackish above, pure white below, including the scales themselves, and usually with the terminal centimeter or so white all around. Thomas mentions that one specimen from the type locality had a few pale-buffy hairs along the middle line of the belly, but usually there is no trace of the stripe of this color so characteristic of the typical race.

Measurements.—The type specimen measured: head and body, 78 mm.; tail, 144; hind foot without claws, 28. The tail is thus apparently absolutely as well as proportionally longer than in the typical race, forming 64 per cent of the total length in the type, but it is very likely that the measurements given by Pousargues were not taken from the fresh specimens. A well-made skin from near Choni, Kansu, though not accompanied by field measurements, agrees almost exactly with the above figures.

The measurements of available skulls follow:

CRANIAL MEASUREMENTS OF *ZAPUS SETCHUANUS VICINUS*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
12.8.5.62 BM (type)	21.5	17.0	10.0	11.1	10.3	4.5	3.7	3.5	Kansu
84263	22.6	17.4	10.5	11.8	10.9	5.0	4.0	3.8	Kansu
84264	—	—	11.1	12.5	—	5.4	4.0	3.5	Kansu

Occurrence and Habits.—This race differs from the typical form of the southern mountains of Szechwan chiefly in its wholly pure-white belly. Some have the entire tip of the tail white, as in the American *Napæozapus*, to which in its bright ochraceous coloring the race *Z. s. vicinus* bears much outward resemblance, though it has one more upper tooth on each side, the small pre-molar. In addition to the three recorded by Thomas in describing the species, collected at a locality in the mountains forty-six miles southeast of Taochow,

Kansu, several others have since been secured slightly to the southward in the mountains near Archuen and Choni in the southeastern part of the same province. The American Museum Asiatic Expeditions secured one at each of these localities, and the U. S. National Museum also has one from each. Since this region is partly under mixed spruce forest and in mountains reaching altitudes of 10,000 feet, one might infer that like the American relative, *Napæozapus insignis*, it prefers cool woods in the vicinity of small brooks.

Specimens examined:—Three, namely:

Kansu: southeast of Taochow, 1, the type (B.M.); Archuen, 1; mountains ten miles southwest of Choni, 1.

Family DIPODIDÆ

JERBOAS

The members of this family are chiefly desert-living animals that have developed many peculiarities adapting them for life in this type of habitat. The feet are elongated for saltatorial progress, and the tails are also proportionally long, acting as a counterpoise. Most of the species seek shelter by excavating burrows and hence have the claws of the fore feet strong for digging; the ears may be short or of medium length in correlation with burrowing habits, but in some species they are longer, as in *Allactaga*, or even, as in *Euchoreutes*, of relatively enormous size. Usually, too, the skull shows an enlargement of the bones of the auditory region, so that the bullæ are sometimes the largest part of the skull. The specialization of the feet results in the reduction of the lateral toes, as in *Allactaga*, or their entire loss, as in *Dipus*, with the further adaptation that the three remaining metatarsals may be fused to form a cannon-bone. The skull, as in the Zapodidæ, has a very large antorbital foramen for the transmission of muscle in the upper part and of nerve in the lower, and this enlargement results in forcing the zygomatic plate outward so that it becomes ventral to the foramen instead of forming its lateral wall, and the dorsal bridge is extended outward. The molars have their crowns higher, and the small premolar is either vestigial or absent. Vinogradov (1925), who has made a special study of the male genitalia, shows that, whereas in the Zapodidæ the baculum is always present and is simple, without a prominent median crest at its basal part, in the Dipodidæ it is lacking in the genus *Allactaga*, and in the genera where present is distinguished by having a prominent median crest at its base. The glans penis is stout, and characterized by having well-developed horny spines or "scales" directed backward. He divides the family into four subfamilies, chiefly on the characters of the external genitalia, namely, the Allactaginæ for the common five-toed jerboas, the Euchoreutinæ for the long-eared *Euchoreutes*, Dipodinæ to include *Dipus* and *Scirtopoda*

(and *Stylodipus*), and lastly, the Salpingotinæ and Cardiocraniinæ for the two dwarf jerboas with peculiar characters, *Salpingotus* and *Cardiocranius*. The jerboas extend in range from eastern Europe across the arid parts of central Asia to the eastward, with several genera inhabiting the Gobi of Mongolia as an eastern reëntrant from this central area. Other members of related genera occur in northern Africa.

The genera found in Mongolia may be identified by the following key, based mainly on external characters.

KEY TO GENERA OF MONGOLIAN DIPODIDÆ

- A. Hind foot with five toes, two small and lateral, three central and larger.
 - a. Upper incisors not grooved, ears moderate or large, bullæ not greatly enlarged.
 - a'. Ears narrow, about the length of the head.
 - a''. Larger, hind foot more than 60 mm. long; upper small premolar present. *Allactaga*
 - b''. Smaller, hind foot less than 60 mm.; upper small premolar absent. *Alactagulus*
 - b'. Ears broad, much longer than head. *Euchoreutes*
 - b. Upper incisors grooved, ears small, bullæ enormous. *Cardiocranius*
- B. Hind foot with three toes, the lateral ones lacking.
 - a. Size larger, head and body more than 120 mm.; upper incisors grooved; bullæ little or moderately inflated.
 - a'. Tail ending in a conspicuous flattened tuft, black with white tip; upper premolar lacking. *Dipus*
 - b'. Tail not tufted, but distichous throughout, colored like the back; minute upper premolar present. *Stylodipus*
 - b. Size smaller, head and body less than 90 mm.; upper incisors grooved; bullæ enormous. *Salpingotus*

Genus *Allactaga* F. Cuvier

FIVE-TOED JERBOAS

Allactaga F. Cuvier, Proc. Zool. Soc. London, 1836, p. 141.

Dipus Zimmermann, Geogr. Geschichte Menschen u. vierfüß. Thiere, vol. 2, p. 358, 1780 (in part); and of other later authors.

Alactaga F. Cuvier, Trans. Zool. Soc. London, vol. 2, p. 133, 1838.

Jaculus Milne-Edwards, Recherches pour servir à l'Hist. Nat. des Mammifères, p. 149, 1868-74 (as a subgenus).

The name *Allactaga* or *Alactaga* is said to be derived from the Mongol word Alak-daagha, the first part of which signifies variegated and the second, colt, a connection rather difficult to see. The genus is characterized by the possession of five toes in the hind feet, the outermost and innermost of which, however, are much shortened, barely reaching the base of the other three toes. These latter form the supporting part of the foot, the middle toe slightly the longest, the two others subequal, terminating in prominent rounded pads and

well-developed slender claws. The metatarsus is long and slender, haired on the under side, but the sole of the foot beneath the tips of the three middle toes is provided with a tuft of longer, stiffer hairs which acts as a friction pad. Posterior to this, beneath the bases of these toes, is a small oval tubercle or pad. The ear is rather long, about the length of the head, and the vibrissæ, though mostly short, include one or two of much greater length which, if laid back, reach to the middle of the thorax. The long tail considerably exceeds the head and body, is short-haired for most of its length, but the terminal third or fourth has a feather-like tuft of longer hairs which extend laterally and form a supporting surface which is applied to the ground when the animal is at rest.

The skull shows a number of peculiar features. The large antorbital foramen looks directly forward, is about one-third the size of the combined orbit and temporal fossa and is nearly oval vertically. At its ventral inner margin a thin plate of bone arises from the slender zygomatic plate and slopes inward against the wall of the skull, forming a roofed-over passage for the fifth nerve. A long slender branch of the jugal extends upward at right angles to the zygomatic arch to a contact with the lachrymal, and forms the posterior half of the outer side of the bony ring constituting the antorbital foramen. There are no postorbital processes. In ventral view the audital bullæ are not disproportionately large; the incisive foramina are long and slightly bowed outward, extending to the level of the cheek teeth; the bony palate is continued well behind the last molar, and ends in a median projection. A pair of small oval foramina is present in the palate about opposite the second molar. The incisors are white and in the upper jaw are much narrower even than the slender rostrum. The small upper premolar is nearly circular in crown view, and of about the size and shape of the reduced last molar. The first upper molar is the largest, with one nearly transverse reëtrant in the center of its inner side, while on the outer side there are two such reëtrants, extending inward then backward and separating between them a lateral lobe which at its outer extremity has a shallow infolding of the enamel. The second upper molar is similar but slightly shorter. With wear these infolds become cut off to form two small round enamel lakes in the middle of the tooth. The mandible is long and slender, of very shallow depth, the condyle only a little elevated above the crowns of the teeth, and widely separated from the short coronoid process. At the angle of the jaw is a somewhat oval opening or fenestra. The lower incisors are as slender as the upper, with very long roots that pass beneath the molar row and terminate in a projecting capsule exterior to the condyle and slightly below it. The last lower molar is somewhat larger than that of the upper jaw. The enamel pattern of the lower molars resembles that of the upper, though reversed, but with this difference, that the first lower molar has a reëtrant in the center of its front end and the second has a similar but smaller

one at the antero-external corner. The last lower molar has an inner and an outer reëntrant so that there are two external and two internal lobes. The tooth formula is: $i. \frac{1}{1} c. \frac{0}{0} pm. \frac{1}{0} m. \frac{3}{3} = 18$. The type species is the large *Mus jaculus* Pallas of southern Russia = *Allactaga major* (Kerr).

Two species of this genus occur in the Gobi and surrounding desert regions, with at least one recognizable subspecies in addition. They may be known by the following key.

KEY TO MONGOLIAN SPECIES OF *Allactaga*

- A. Audital bullæ not noticeably enlarged, upper incisors obviously thrown forward.
- a. Slightly larger and darker, hind foot usually more than 71 mm., greatest length of skull usually over 39 mm. *A. sibirica sibirica*
 - b. Slightly smaller and paler, hind foot usually less than 71 mm., greatest length of skull usually less than 39 mm. *A. sibirica annulata*
- B. Audital bullæ enlarged and globular, upper incisors nearly vertical. *A. bullata*

454. *Allactaga sibirica sibirica* (Forster)

MONGOLIAN FIVE-TOED JERBOA

[*Yerbua*] *sibirica* Forster, Kongl. Vet.-Acad. Handlingar Stockholm, p. 114, 1778. Transbaikalia.

Mus saliens Shaw, Naturalist's Misc., vol. 2, p. 38, 1790. Transbaikalia.

Dipus sibiricus Kerr, Animal Kingdom of Linnæus, vol. 1, p. 274, 1792.

Dipus sibiricus medius Kerr, *loc. cit.*

Dipus brachyurus Blainville, Nouv. Dict. d'Hist. Nat., ed. 2, vol. 13, p. 126, 1817. Transbaikalia.

Dipus jaculus var. *mongolica* Radde, Reisen im Süden von Ost-Sibirien, vol. 1, p. 170, pl. 8, fig. 3a-b, 1862. Tarei Nor, Mongolia.

Allactaga mongolica G. M. Allen, Amer. Mus. Novitates, no. 161, p. 1, 1925.

Alactaga saliens Chaworth-Musters, Ann. Mag. Nat. Hist., ser. 10, vol. 14, p. 559, November, 1934.

Type specimen.—No type specimens were mentioned in the older descriptions; it appears that the name [*Yerbua*] *sibirica* Forster is the earliest applied to the five-toed jerboa of the Transbaikalian region. Radde (1862), in naming his var. *mongolica*, speaks of fourteen specimens from Tarei Nor on the north-east border of the Gobi and Transbaikalia which he himself collected. Presumably these cotypes of his description are in the Zoological Museum of the Academy of Sciences at Leningrad.

Description.—General color a mixed russet and black, the tint depending somewhat on fading and wear, but usually darker than in the race *A. s. annulata*, more buffy and less gray above. Tip of the muzzle and back of the nose blackish. Ears as long as the head, well haired, similar to the back on the proëctote, and darker, more nearly brownish on the metentote. Hairs of the back dark, mostly with short black points and brownish-yellow subterminal zone, then a broad slaty-gray base. Tail pale russet above and mixed with black, the hairs all short and appressed, except in the terminal fourth which is

expanded as a broad conspicuous feather, pure white all around proximally, then the central three-fifths black, and the terminal fifth or less white. The pattern on the under side may differ slightly from that above, with usually most of the shaft of the tail whitish, and about half of the proximal part of the feather white, as well as a narrow median area connecting the proximal white part with the white tip. Backs of the feet whitish; belly, upper lips and inside of the limbs pure white to the roots of the hairs.

The skull has been described in general under generic characters, and additional particulars are given under *A. s. annulata*. That of this race is similar but slightly larger.

Measurements.—In addition to its slightly darker color, this race of the five-toed jerboa from northeastern Mongolia is a little larger than that of the Gobi to the south and west. This comes out especially in the hind foot measurement which in specimens from northeastern Hopei, northern Mongolia and Transbaikalia is several millimeters longer, about 71-74 as against about 67 in the other race, including claw. Specimens from the eastern Gobi are usually less. The following measurements of the hind foot are, with one exception, from specimens in the British Museum:

No.	Hind foot with claws	Locality
5.2.1.10 BM	70.3	Mongolia
91.6.29.6 BM	73.8	Mongolia
9.10.15.6 BM	73.7	Siberia
23.12.1.74 BM	77.5	Transbaikalia
16.1.1.10 BM (claw turned up)	72.0	Jehol
16.1.1.11 BM	73.0	Jehol
15.2.16.3 BM	73.8	Jehol
20589 MCZ	71.0	Jehol

For cranial measurements, see table under *A. s. annulata*.

Nomenclature.—An extended research by Chaworth-Musters (1934) into the history of the earliest names applied to this jerboa has resulted in an overturning of those previously in use. He shows that *Mus saliens* of Shaw applies to this animal rather than to the larger species for which it has been used and was based on Brisson's description of *Cuniculus pumilio saliens*, which in turn was taken from Gmelin's description (Novi Comment. Acad. Sci. Imp. Petropol., vol. 5, p. 351, 1760), where no binomial designation is given. Kerr's names *Dipus sibericus* and the variety *medius* also apply to the Transbaikalian animal, as does Blainville's *Dipus brachyurus*. In a still later communication, however, Chaworth-Musters (1937a) brings up a yet earlier name, previously overlooked, the *Yerbua sibirica* of Forster, likewise based on the animal of Transbaikalia. Since this appears to be the first name applied to the species,

it stands as the valid specific term, and supersedes Radde's "var. *mongolica*," so long in use.

Occurrence and Habits:—The typical five-toed jerboa of northeastern Mongolia and the adjacent regions differs subspecifically from the slightly smaller and paler animal of the greater part of the Gobi. The slightly darker color and (usually) larger hind foot are distinctive characters, but intermediate specimens in central Hopei and the southeastern part of the desert show that there is no sharp line of difference. Radde indicates a wide distribution for it from the Manchurian border westward across Transbaikalia to the middle Selenga region. It avoids mountainous country. Radde notes that it was active in the hours of dusk, and in the spring of the year lived chiefly on the bulbs of a species of *Gagea* (*G. uniflora*). It first appeared from hibernation about April 19, and in early September retired once more to its winter state in soft nests constructed in a burrow, the entrance of which it closes with a thick plug of earth.

To this slightly darker race, specimens in the British Museum from Chihfeng, Jehol, seem referable, as well as one in the Museum of Comparative Zoölogy from Chengteh, Jehol, one of several recorded by Jacobi (1922). Doubtless, too, the dark specimen recorded by Rhoads (1898) as possibly a race "as yet undescribed" from a valley on the border of the Khingan Mountains is the same. Little seems to be recorded of the distribution at this extreme eastern end of Mongolia.

Specimens examined:—The following eight:

Mongolia (northeastern):

Halintei Spring, 1 (B.M.); Kentai Mountains, 1 (B.M.).

China:

Jehol: Chihfeng, 3 (B.M.); Chengteh, 1 (M.C.Z.).

Siberia:

Transbaikalia: Sharagolskaia, 1 (B.M.); Lake Baikal district, 1 (B.M.).

455. *Allactaga sibirica annulata* (Milne-Edwards)

GOBI FIVE-TOED JERBOA

Dipus annulatus Milne-Edwards, Ann. des Sci. Nat., Zool., ser. 5, vol. 7, p. 376, 1867.

Dipus (Jaculus) annulatus Milne-Edwards, Recherches pour servir à l'Hist. Nat. des Mammifères, p. 149, pl. 10; pl. 10A, fig. 3, 1868-74.

Allactaga annulata Buechner, Bull. Acad. Imp. Sci. St. Pétersbourg, vol. 34 (new ser., vol. 2), p. 113 (Mélanges Biol., vol. 13, p. 159), 1892.

Allactaga mongolica Thomas, Proc. Zool. Soc. London, 1908, p. 109; *ibid.*, for 1908, p. 979, 1909.

Allactaga mongolica longior Miller, Proc. Biol. Soc. Washington, vol. 24, p. 54, 1911. Chingningchow, Kansu.

Type specimens:—As usual, no type specimen is mentioned in the original description, which is based on specimens in the Paris Museum, sent about 1867

by Père Armand David who collected them in the sandhills of Inner or Chinese Mongolia, as it was then called, evidently in the southeastern Gobi, perhaps not far from Kalgan. One of these specimens is in the British Museum, and may be considered a cotype.

Description.—A slightly paler desert race, with on the average a smaller foot, seldom in dried skins measuring over 67 mm. with claw. The general coloration of the dorsal side is a sandy buff, the long silky hairs of the back having slaty-gray bases, then a short ring of bright to pale buff and a minute black point. Scattered amongst these are a very few all-black hairs. The sides are paler, with fewer black-tipped hairs, and vary in tint from warm buff to pale grayish buff, nearly clear on the cheeks behind the eye. Muzzle scarcely darker than the rest of the head, which is somewhat paler grayish than the back. A small white spot at the outer base of each ear. Tail bicolor nearly all the length of the shaft, varying individually from sandy buff mixed with black to nearly clear tawny, to the base of the terminal expanded feather, which is first white above and below, then all-black above for the middle three-fifths of its length, then white for the terminal fifth. On the under side the tail is whitish throughout, except that on the middle three-fifths of the feather-like tip there is a narrow white isthmus connecting the white of the base with that of the tip and dividing the otherwise black expansion ventrally. A white stripe on the posterior hip extends part way across the upper hind leg. Upper and lower lips, the backs of the feet, forearms and the entire under surface of the body and limbs, pure white to the roots of the hairs, except that the tuft of elongate stiff hairs under the toes of the hind foot is dark brownish.

The skull is like that of typical *A. s. sibirica*. The nasals end behind nearly straight across at or slightly ahead of the tips of the premaxillaries; the fronto-parietal suture is nearly a straight transverse line at right angles to the median suture. The interparietal is large and more or less hexagonal in outline, or quadrilateral, with a longer transverse anterior border and a shorter posterior one, or the anterior boundary may have its lateral portions bent back to make three sides of a hexagon. The bullæ are not noticeably enlarged or globular, not extending forward to the level of the edge of the glenoid fossa, while their length from the lower lip of the meatus to the antero-internal corner is practically the same as the length of the alveolar row.

Measurements.—The long tail, greatly exceeding the head and body, and the long hind limbs with their elongate hind feet are the outstanding features of this animal, while the rather long narrow ears, about equaling the head in length, give the latter a peculiarly rabbit-like appearance which is enhanced by the creature's habit of sitting erect. The very long posteriormost vibrissæ when laid back extend to the upper chest, and may have significance in balance.

The following measurements are from fresh specimens, except that the hind foot length, in order to be comparable with other specimens studied, is measured from the dry specimen, in which it is extended quite straight, and includes claw:

No.	Head and body	Tail	Hind foot	Ear	Locality
58662	128	190	70.0	40.0	Mongolia
58675	125	191	68.0	40.0	Mongolia
58778	138	188	71.0	39.0	Mongolia
58828	125	195	69.0	40.0	Mongolia
84174	120	187	69.0	39.0	Mongolia
84178	128	190	67.0	38.0	Mongolia
84207	120	180	68.0	40.0	Mongolia
13655 MCZ	140	202	72.5	44.5	Kansu
58688	130	202	71.0	42.0	Mongolia
58775	130	187	70.0	43.0	Mongolia

While the hind foot seems to average a very little shorter than in northern specimens of *A. s. sibirica*, it is true that there are large individuals that are rather indistinguishable unless it be by a slight difference in color. The length of the ears is fairly constant but, on account of different methods in making up skins or taking this dimension, may appear to vary more than it actually does. Specimens from Chingningchow, Kansu, made the basis of the name *A. mongolica longior*, on account of the apparently longer ears, seem on further comparison to be no different from specimens taken elsewhere over the Gobi and its borders.

CRANIAL MEASUREMENTS OF *ALLACTAGA SIBIRICA*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
<i>A. sibirica sibirica</i>									
16.1.1.11 BM	40.8	34.8	25.7	26.6	20.0	9.7	8.5	8.4	Jehol
16.1.1.10 BM	39.5	34.3	25.3	25.5	19.8	9.9	8.2	8.6	Jehol
15.2.16.3 BM	40.3	34.8	27.5	26.2	21.0	9.5	7.4	7.6	Jehol
20589 MCZ	39.7	35.4	25.0	25.4	20.3	9.2	8.5	7.4	Korea
<i>A. sibirica annulata</i>									
23.12.1.75 BM	37.3	31.5	22.6	24.4	19.5	8.9	6.7	6.7	Altai
13655 MCZ	38.5	32.6	22.4	25.5	20.2	9.3	7.1	8.0	Kansu
(topotype of <i>A. m. longior</i>)									
24147 MCZ	39.3	34.4	24.5	25.5	21.3	9.6	7.5	7.7	Kansu
58675	37.8	32.5	22.7	24.9	20.2	8.8	6.4	6.7	Mongolia
58778	37.6	33.1	23.0	25.3	20.7	9.5	6.8	6.6	Mongolia
58792	39.1	33.9	23.6	26.0	21.6	9.5	6.9	7.2	Mongolia
58828	36.5	31.6	22.2	25.1	20.1	9.3	7.0	7.4	Mongolia
84174	36.6	31.8	22.0	23.8	20.5	8.9	6.8	7.6	Mongolia
84191	36.5	31.6	22.5	22.6	21.0	8.5	7.0	7.0	Mongolia
84205	36.9	31.5	22.3	23.0	21.3	8.6	7.0	7.6	Mongolia

Nomenclature.—There is still some doubt as to the correct combination of names to be used for these jerboas. Thomas (1912a) recorded as *Allactaga saltator* Eversmann two individuals evidently of this species: one from Suok, western Mongolia, and another from the same region at the entrance to Chuia steppe, southeastern Altai, and so from near the same region as the type of that species. If this identification is correct, and I have examined the material in the British Museum, Eversmann's name would supersede *A. s. annulata* as a subspecies of *A. s. sibirica*. But Eversmann's account, although leaving much to be desired, deals with a small species with a tail tuft that is white anteriorly and wholly black at the tip, as in the small species sent me by the Academy of Sciences at Leningrad as *A. elater*. No measurements are given by the describer, but it seems evident that his figure was intended to be of natural size, hence none was thought necessary. The hind foot, as figured, measures 50 mm., which agrees with that of my specimens of the smaller species, hence it seems most probable that the name *A. saltator* does not apply to the species so common in the Gobi. For reasons already given, I have regarded *A. m. longior* as a synonym of *A. s. annulata*.

Occurrence and Habits.—This jerboa is an abundant species in the Gobi from southern Hopei westward, including the desert regions of northern Shansi, the Ordos, and northern Kansu, northward across to the region of Urga, northern Mongolia. Nevertheless, the distribution is somewhat sporadic, dependent on the presence of proper conditions of vegetation and terrain. Dr. R. C. Andrews, in making the traverse from Kalgan to Urga, took the first specimens at Pangkiang at the southern border of the Gobi. The soil here is fine gravel, and the only vegetation is short bunch-grass. He writes: "We continued to get the species at Turin which is on the northern edge of the Gobi. Here they were all taken out on the plain and were abundant. This region is less desert, for it begins to merge into the grasslands of outer Mongolia. I also found this species on the plain north of Turin and on the bare hills in the immediate vicinity (20 miles south) of Urga," thus tracing it quite across the desert. At Iren Dabasu it was much less common than *Dipus*. Farther west, series were secured at Artsa Bogdo, Tsagan Nor, Uskuk, Hurumtu, Tsetsen Wang, and at Shabarakh Usu. Buechner (1892) recorded it from the Ordos Desert, and Clark and Sowerby (1912) secured a series, which later became the basis of the name *A. m. longior*, at Chingningchow, Kansu. This lot appeared to be part of a local colony, for, though these collectors found them numerous, they did not meet with them elsewhere. Thomas (1909) notes, in connection with a specimen taken at Ningwufu, central Shansi, that tracks were abundant on the loess plains in that vicinity. There seem to be no records for Shensi, but it probably occurs along the edge of the Ordos Desert. Dr. Andrews tells

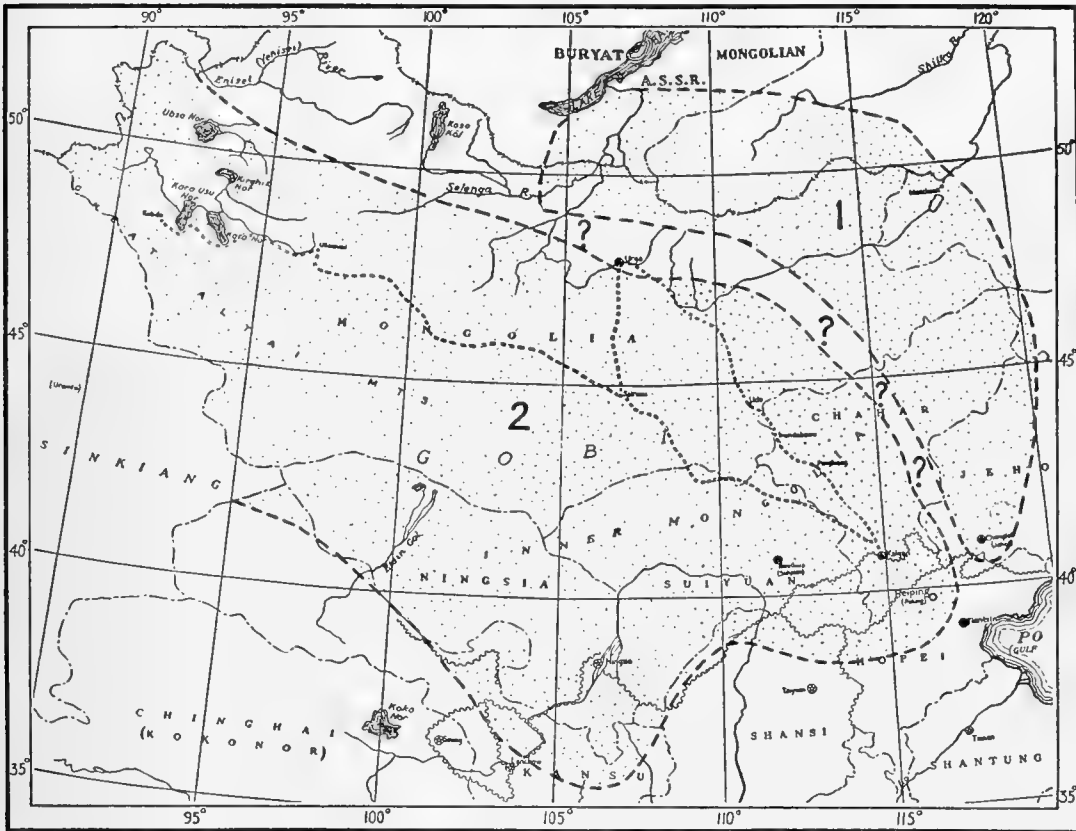


FIG. 55. Distribution Map.

*Allactaga*1. *A. sibirica sibirica*2. *A. sibirica annulata*

me that they live singly and also in colonies of half a dozen holes, these latter of about 1.5-2 inches in diameter. He found them active by night and often saw their eyes shine in the light of the motor-car lamps. "Although I chased them several times, they could easily out-jump me. They kept always in the path of the lights." Rarely they may be found abroad by day. Sowerby mentions that in leaping they may cover from two to six feet at a bound.

The possible relation of this species to plague has been suggested by Wu Lien-teh (1930). Sowerby (1914, pl. 26) has published an excellent photograph of a live specimen, showing its curious attitude when at rest, with the long legs folded beneath it, and the tail held with a strong upward bend in its basal two-thirds, with the terminal feather touching the ground, or it may rest this part flat on the surface.

Among the extensive series taken by Dr. Andrews and his associates, there is a large preponderance of males in the early part of the season. Thus, of one hundred and seventeen specimens taken in May and early June, all but fifteen

were of that sex, whereas in August the proportion seemed reversed, with only five males to fifteen females. This may indicate that after coming out from hibernation the males are the more active, or appear earlier, and are seeking the females for mating, or the latter are perhaps already occupied with their young. Curiously, no young ones were secured.

Specimens examined.—The following two hundred and fifty-five:

China:

Shansi: Ningwufu, 1 (B.M.).

Kansu: Chingningchow, 1 (M.C.Z.); near Choni, 1 (M.C.Z.).

Mongolia:

Artsa Bogdo, 10; ten miles north of Artsa Bogdo, 1; Bailing Miao, 2; Baron Sog-in-Sumu, 1; Erhlien, 6; twenty-three miles south of Erhlien, 17; Hatt-in-Sumu, 3; Hurumtu, 5; Gun Burte, 3; Iren Dabasu, 3; Loh, 1; Pangkiang, 1; northwest of Paotow, 1; Sainnoin Khan, 3; Sair Usu, 1; one hundred and sixty miles east of Sair Usu, 4; Shabarakh Usu, 49; Suok, 1 (B.M.); Tsagan Nor, 25; forty-five miles east of Tsagan Nor, 1; Tuerin, 57; forty miles south of Tuerin, 5; Tola River, west of Urga, 6; Tsetsen Wang, 1; thirty miles northeast of Tsetsen Wang, 2; forty miles northeast of Tsetsen Wang, 5; Ula Usu, 1; Uskuk, 8; twenty miles southwest of Urga, 29.

456. *Allactaga bullata* G. M. Allen

Allactaga bullata G. M. Allen, Amer. Mus. Novitates, no. 161, p. 2, 1925.

Type specimen.—An adult male, skin and skull, No. 58723, American Museum of Natural History, from Tsagan Nor, Outer Mongolia. Collected July 5, 1922, by the Central Asiatic Expeditions.

Description.—In color and general appearance similar to *A. sibirica annulata*, exhibiting the same grayer or buffier phases, but the ears shorter, hind feet smaller, and the skull with much larger, more nearly globose audital bullæ. The dorsal surface of the head, ears, body and outer sides of the thighs, grayish buff or in some specimens a brighter pale buff, clearer on the sides of the face below the ears and along the flanks. The individual hairs are slaty at base with a short buffy subterminal ring, and a black point, usually minute but sometimes half as long as the buffy ring. Mixed with these on the back are scattered longer black hairs. An indistinct spot above the eye, paler gray; and a spot of pure white at the external base of the ear. Lower side of the body, forearms, hind legs, and the upper lip, pure white to the roots of the hairs; a prominent hip-stripe on the posterior half of the thigh externally. Backs of the feet thinly covered with short white hairs. Tail white all around at the very base, then pale ochraceous to tawny above to the base of the terminal tuft, which is white for about 10 mm., slightly darkened by black hairs among

the white; then follows the main part of the distichous tuft, which is blackish for some 45 mm., then the short pure white tip of about 20 mm. The under side of the tail is pale ochraceous basally, shading into whitish, then pure white. On the under side of the expanded terminal tuft, the white is narrowly continuous from the base to the white tip, dividing the otherwise black tuft by a narrow central white line. The hind feet are dark brownish in a narrow line along the sole, with a larger blackish area beneath the basal phalanges. The lateral hind toes extend to the bases of the central phalanges, the median toe, the third, about 5 mm. longer than the subequal second and fourth.

The skull is in general like that of the larger species, but is of smaller size, the upper incisors similarly white, but less thrown forward. The brain case is more abruptly expanded behind the interorbital constriction, but the most obvious difference is in the greatly inflated bullæ, which are nearly three times the volume of those of *A. s. annulata*. They are so closely approximated medially that the basioccipital is only one-half as broad as in the latter, and their extreme antero-internal tips are nearly in contact. In front they extend nearly to the back of the glenoid cavity. The interparietal differs in having its anterior outline bracket-shaped, with the median point anteriormost. The cheek teeth are similar in pattern, but slightly smaller than in *A. s. annulata*.

Measurements.—The slightly shorter and broader ears and shorter hind foot are the most obvious differences in external dimensions as compared with *annulata*. The following are from fresh specimens taken by the collector in the field:

No.	Head and body	Tail	Hind foot	Ear	Locality
58594	120	177	64	33	Mongolia
58723 (type)	105	188	70	40	Mongolia
58727	110	175	66	38	Mongolia
58729	122	165	65	31	Mongolia
58735	133	188	67	34	Mongolia
58737	130	174	64	34	Mongolia
58738	118	175	66	34	Mongolia
58744	130	195	68	36	Mongolia
58823	116	171	65	31	Mongolia
58827	125	175	67	33	Mongolia

Of the forty specimens examined, only the type specimen has ears longer than 38 mm., and a hind foot measurement of more than 68 mm., suggesting that perchance the skull of that individual was by mistake associated with a specimen of *A. sibirica annulata*, a possibility not noticed at the time it was described. More likely, however, there was a mistake in the measurement, for on the specimen the hind foot extended measures 65, which is the average in the species.

CRANIAL MEASUREMENTS OF *ALLACTAGA BULLATA*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
58723 (type)	—	—	21.0	24.0	22.3	—	6.5	6.3	Mongolia
58742	33.0	29.6	19.7	22.9	20.7	8.0	6.7	6.4	Mongolia
58747	33.4	29.8	20.1	23.4	21.3	8.3	6.5	6.9	Mongolia
58825	33.0	28.9	19.4	20.7	20.8	8.0	6.2	6.1	Mongolia
84206	35.1	30.8	21.3	24.3	22.3	8.1	6.5	6.5	Mongolia
84216	33.5	29.8	19.7	22.6	21.4	7.8	6.5	6.5	Mongolia

Occurrence and Habits.—This fine addition to the known species of the desert-living jerboas was one of the discoveries of Dr. Andrews's work in the Gobi. While externally distinguishable from the other species, *A. s. annulata* of the same desert, by its shorter ears and hind feet, the difference is not very great and the two are identical in color; the skulls, however, separate them at once, *A. bullata* having much larger bullae and nearly vertical upper incisors. In the type the longest diameter of the bulla is 10.3 mm., and the transverse diameter 7.6; the corresponding measurements in an adult of the other species are: 7.1 and 4.7. Dr. Andrews found this species in fair numbers at Tsagan Nor, Shabarakh Usu, and at a camp some twenty-three miles south of Erhlien, while single specimens were taken at Sair Usu at the east end of Lan Shan, and

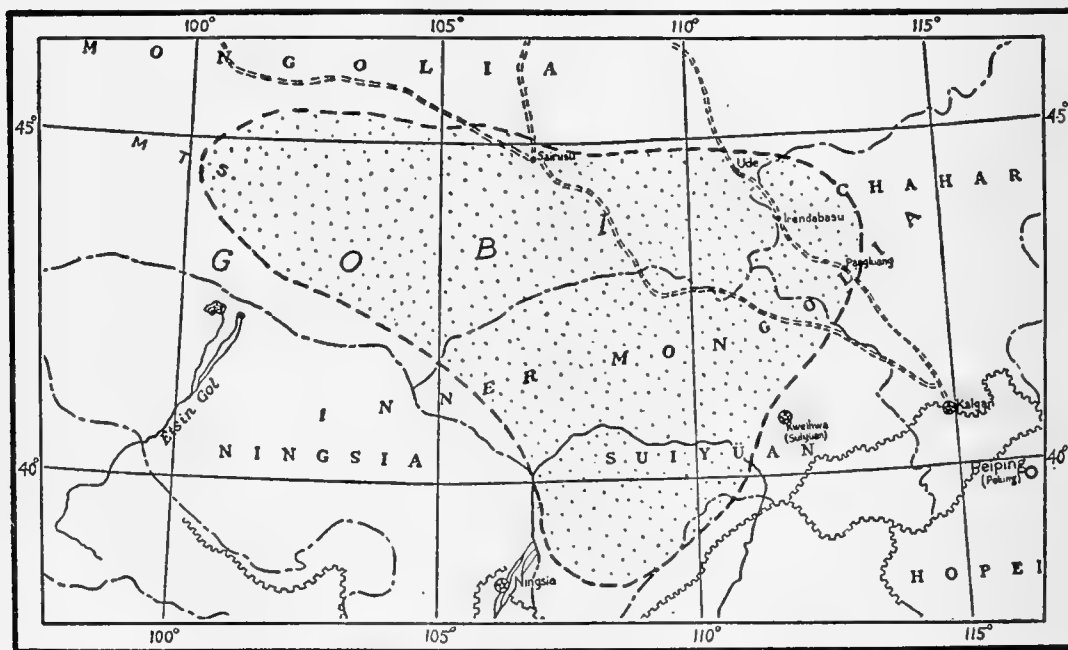


FIG. 56. Distribution Map.

Allactaga bullata

at a point just north of the Ordos, some two hundred miles northwest of Paotow. Nothing distinctive was learned as to its habits. It is remarkable that the larger bullæ go with the shorter ears, and this is paralleled by other mammals of this type. Thus *Dipus* with its short ears has enormous bullæ, and *Euchoreutes* with enormous external ears shows little proportionate enlargement of the bullæ. Perhaps therefore there is a compensatory development, partly dependent on habits, as burrowing. Since the recognition of this species, Vinogradov (1926) has recorded six others collected by Kozakevich and P. Kozlov in the central Gobi at Onchi Gurgul, Kholoin Gashun, Bainbulyk, and in the northern Gobi between the Tuin Gol and Tatsin Gol.

Specimens examined:—The following forty:

Mongolia:

Tsagan Nor, 17; twenty-three miles south of Erhlien (Iren Dabasu), 6; Sair Usu, 1; one hundred and sixty miles southeast of Sair Usu, 1; fifty miles west of Sair Usu, 2; Shabarakh Usu, 11; east end of Lan Shan, 1; two hundred miles northwest of Paotow, 1.

Genus *Alactagulus* Nehring

Alactagulus Nehring, Sitzungsab. Ges. Naturf. Freunde, Berlin, 1897, p. 154, fig. 1 (as a subgenus). Vinogradov, Proc. Zool. Soc. London, 1925, p. 579, pl. 1, fig. 7 (as a genus).

As the name implies, the jerboas of this genus are in many respects but a smaller form of the common *Allactaga sibirica* or the still larger *A. major*. Externally the ears are narrow and about as long as the head; the long hind legs and feet are similar, the latter with the first and fifth digits short, subequal, reaching, with claws, not quite to the base of the other central toes, of which again digit 3 is a little the longest. The fore feet have the thumb reduced, but provided with a small flat nail, while the other digits have long claws for digging. The tail is much longer than head and body, but its terminal tuft is less developed than in *Allactaga*, consisting of much shorter hair, grading by imperceptible degrees from the closely appressed hair of the main shaft of the tail to the tuft at the tip which is slightly flattened. The mammae are, as usual, eight, two pairs pectoral, two pairs abdominal. The skull is a smaller replica of that of the larger genus, but the rostrum is relatively shorter, the incisive foramina wider, extending back to the level of the first molar. The two palatal foramina are larger and oval, occupying so much space that a very narrow bridge of bone, about as wide as half the length of the first molar, intervenes between them and the incisive foramina. The lachrymal bone is differently shaped, being long and narrow transversely and extending from the anterior corner of the frontal out to meet the ascending arm of the slender jugal. As in *Allactaga*, the upper incisors are distinctly proclivous and very narrow, white and ungrooved. The audital bullæ are normal, without any conspicuous inflation, although the mastoid region is enlarged slightly.

The dentition differs from that of *Allactaga* in lacking the small upper pre-molar, so that the formula is: $i. \frac{1}{1} c. \frac{0}{0} pm. \frac{0}{0} m. \frac{3}{3} = 16$. The pattern of the enamel, as first pointed out by Nehring, is also different. The first two upper molars are of nearly equal size, the second a very little the smaller. Their inner margin has a single V-shaped reëntrant extending transversely about half the diameter of the tooth, so that the enamel of the lingual border has a very regular W-shaped outline. From the outer border of each tooth, two transverse reëntrants extend in similar fashion half-way across the crown, with expanded oval tips, making three equal lobes on the outer side, the anteriormost and posteriormost with their outer ends bent in toward the median one. The third upper molar is much smaller, less than half the crown area of the one in front, and soon wears to a simple circle of enamel. In the lower molars the pattern is a little more varied. The first molar is the longest, and has at its antero-external corner a small right-angled notch, followed by two subequal reëntrants, extending half-way across the crown; the inner margin shows quite similar folds, so that the tooth is nearly symmetrical, with a small median anterior lobe, followed by three opposite pairs of enamel lobes. In the second lower molar the small right-angled notch is lacking on the inner side, which thus consists of three equal lobes, while on the outer side there is a small angular notch at the front corner of the tooth, followed by a deeper one cutting off two lobes corresponding to the second and third of the inner border. The third lower molar is relatively larger than the upper one, and has a single reëntrant from each side, the outer extending farther back than the inner, and so making two larger pointed triangles on the outer side, and two smaller rounded lobes on the inner side alternating with them.

The type of the genus is *Alactagulus acontion* (Pallas) = *A. pumilio* (Kerr) of southwestern Siberia and the deserts of the eastern Caucasus. The discovery of a member of the genus in the Ordos Desert in recent years adds one more to the genera common to this region and the deserts of western and central Asia.

457. *Alactagulus pumilio potanini* Vinogradov

Alactagulus acontion potanini Vinogradov, Compt. Rend. Acad. Sci. URSS, 1926A, p. 233.

Type specimen.—An adult female in spirit, No. 11957, Zoological Museum of the Academy of Sciences, Leningrad, U. S. S. R., from near the Ulan Muren (about one hundred and twenty kilometers southwest of Kukukhoto), north-eastern Ordos Desert, Mongolia. Collected July 21, 1884, by G. Potanin.

Description.—The type is described as similar to *A. acontion* (= *pumilio*) but distinctly larger, and with somewhat more inflated and rounded bullæ.

This implies a coloring of dull buffy and black mixed, for all the dorsal surface of the head, body, fore and hind limbs, and tail. The amount of black-tipped or all-black hairs is less at the sides, while the upper part of the fore limbs to the wrist is nearly clear pale buff. An inconspicuous grayish spot above and a larger one below the eye, but no white spot at the base of the ear. Tail colored above like the back, but slightly paler below, terminating in a narrow pencil of longer hairs, black, then with a white tip. The bases of the hind feet are buffy, the toes white, and the soles of the feet naked, but fringed at the sides with only slightly longer blackish-brown hairs, not forming a conspicuous pad as in *Dipus*. A broad hip-stripe of white above the posterior part of the haunches. Lower lips, throat, chest and belly, as well as the inner sides of the fore and hind legs, pure white to the roots of the hairs, with a wash of buffy over the thorax.

The general characters of skull and teeth have been briefly noted in the account of the generic differences.

Measurements:—The measurements of the type specimen are given by Vinogradov as follows: head and body, 125 mm.; hind foot, 52; ear from base, 28.0.

The skull showed the following: condylobasal length, 26.5 mm.; nasals, 10.6; diastema, 9.3; width across audital meatuses (mastoid width), 18.0; greatest transverse diameter of bulla, 4.8.

Occurrence and Habits:—The discovery of a specimen of this genus taken in the Ordos Desert more than forty years previous to its recognition by Vinogradov makes an interesting addition to the jerboas now known from the Mongolian area, and is a considerable extension of the range as previously known, since most of the specimens hitherto recorded are from the Kirghiz steppes and Turkestan south to the region east of the Caucasus. In addition to the type specimen from the northeastern Ordos near the Ulan Muren, Vinogradov adds that in the collections of the Zoological Museum at Leningrad he came upon a second specimen of the genus, brought back many years before by Przewalski from northern Alashan and determined by Buechner as a young *Allactaga* "*annulata*," without having examined the skull. On account of its immaturity, however, Vinogradov hesitates to identify it with his *Alactagulus acontion potanini*. Notwithstanding the extensive collecting carried on by the expeditions under Dr. Andrews and others, no further specimens have been found in Mongolia, although evidently to be expected.

For the use of the specific name *pumilio* in place of *acontion*, see Chaworth-Musters (1934, p. 559).

Specimens examined:—None.

Genus *Euchoreutes* W. L. Sclater

Euchoreutes W. L. Sclater, Proc. Zool. Soc. London, for 1890, p. 610, pl. 50, text fig., April 1, 1891.

For this remarkable genus, Vinogradov (1925) proposes a new subfamily, *Euchoreutinae*, allied to the *Allactaginae* in the structure of the foot, which has the outer- and the innermost digits short and subequal, reaching only to the bases of the three central hind toes. The male genitalia show considerable differences in form. The penis of the male has the glans long and slender and its external surface smooth, lacking the short recurved horny points seen in the genus *Allactaga*. The baculum, although slightly expanded basally, differs notably in being a slender rod of about equal diameter throughout, with the terminal part curved upward in a direction at right angles to the main part of the shaft. The fore feet differ in having the first digit, although very short, provided with a strong compressed claw like the others, of which the second and fourth are of equal length and a trifle shorter than the third, while the fifth finger is shorter than the fourth. The most striking peculiarity lies in the external ears which are of relatively enormous size, at least a third greater than the length of the skull and relatively broad. The long slender tail is twice the length of the head and body, short-haired in its basal three-quarters, terminating in a long and rather slender brush which is flattened dorso-ventrally, white at its base and tip, and black between. There are four pairs of mammae, "one pair of pectoral, one pair of inguinal, and two pairs intermediate." The skull, while of somewhat similar form to that of *Allactaga*, differs in many important points. The slender zygomata have the same prominent elbow posteriorly, but the frontoparietal suture, instead of being nearly transverse, is bowed strongly back, so that the median suture of the parietals is much shortened. The audital bullae are greatly enlarged, but rather less than one would have expected from the large size of the external ears. The mastoid portion is inflated and projects about 1.5 mm. behind the level of the occipital, while the bullae are globular and so inflated that they nearly meet in the median line, leaving the anterior part of the basioccipital almost linear. At their postero-internal corner there is a right-angled notch. The incisive foramina are wide and extend back to the level of the center of the first molar, while the palatal foramina are proportionately large and oval, occupying at least half of the palate, and are separated medially by a very narrow bony wall. The palate itself ends behind the level of the last molar. The long hamular processes overlap the enlarged audital bullae. The incisor teeth, as in *Allactaga*, are very narrow and white, but nearly vertical to the cranial axis. The teeth, as in the latter, are: $i:\frac{1}{4}$ $c:\frac{9}{10}$ $pm:\frac{1}{6}$ $m:\frac{3}{4}$ = 18. The upper premolar is small and nearly circular in section, about one-fourth the crown area of the first molar, and with a shallow infold of the enamel on each side of the midline

anteriorly. The first and second upper molars are the largest teeth in the series, with higher crowns than in *Allactaga*. Their essential pattern is the same as in the latter, with a single deep reëtrant half-way on the length of the lingual side, a shallow antero-external reëtrant, and two reëtrants on the labial side, which cut off a large anterior, a narrow middle, and a large posterior cusp. These two large cusps are opposite the two inner ones and of about the same size, elevated above the narrow middle cusp, so that the tooth appears to have two pairs of prominent cusps with a depression transversely between. The last upper molar is slightly less than half the crown area of the premolar, with a nearly circular outline. The lower molars show corresponding modifications.

A single species only is known, with one subspecies which occurs in the Mongolian desert. Specimens are exceedingly few in collections, and little is known of the animal, but it is doubtless a member of the central Asiatic desert fauna. The two original specimens in the British Museum were obtained by the Hon. Charles Ellis in the course of his journey through Chinese Turkestan, probably near Yarkand, in the sandy plains about that city.

458. *Euchoreutes naso alashanicus* A. B. Howell

LONG-EARED JERBOA

Euchoreutes naso alashanicus A. B. Howell, Proc. Biol. Soc. Washington, vol. 41, p. 42, March 16, 1928.

Euchoreutes naso (subsp.?) Vinogradov, Compt. Rend. Acad. Sci. URSS, 1926A, p. 232.

Type specimen:—An adult female, skin, skull and trunk skeleton, No. 240764, U. S. National Museum, from the Alashan Desert, Inner Mongolia, one hundred miles north-northwest of Ningsia, Kansu, China. Collected April 26, 1923, by Frederick R. Wulsin.

Description:—The general coloring is a nearly uniform ochraceous to pale russet above, in contrast to the more sandy hues of *Allactaga* and *Dipus*. The curious "pig-like" rhinarium is a small naked pad into which the nostrils open as usual, but it is set off by a border of minute, stiff, erect hairs (hardly visible without a lens), of a darker blackish than the surrounding hair, mixed with buff, so that they stand out as a minute rim. The sides of the muzzle and an indistinctly marked area between the eye and the ear are whitish, but the rest of the forehead and occiput, the cheeks below the eyes, the nape, dorsum, flanks and the outer sides of the hind legs are bright "buffy ochraceous" or pale russet, slightly paler on the dorsal side of the tail from its base to the white ring below the terminal tuft. The large ears are longer than the head and proportionally broad, their entire inner side and the metectote covered with minute scattered white hairs. The anterior border of the ear is also white along its edge, with an area of slightly longer hairs at the inner base. The proëctote is

buffy ochraceous nearly like the back. A close examination reveals scattered all-black hairs among the russet-tipped fur of the back, but too few to darken the general color. The forearms and backs of the fore and hind feet, and the entire under surface of the body and limbs as well as the throat and lips, are pure white to the bases of the hairs, with a short forward extension of the white of the inner side of the thighs to form a short white stripe part way across the hip. There is the usual prominent tuft of long stiff hair under the central toes, white, not dark. The tail is white underneath, and white all around just below the terminal tuft and at its tip. The tuft is flattened dorso-ventrally and not much more than two and a half times the diameter of the tail at its base. It is black both above and below in its central two-thirds, instead of having the narrow median line of white below.

The general characters of the skull and teeth have been mentioned under the account of the genus. Vinogradov (1930) has figured the teeth and auditory ossicles enlarged, and in his previous paper of 1925, the male genitalia and baculum.

Measurements.—But few measurements of Mongolian specimens are available. The type, as measured by the collector, showed the following: total length, 241 mm. (tail imperfect); tail, 150 plus; hind foot, 41; ear, 41 (ex A. B. Howell). A second specimen from the northern Alashan (No. 23975, M. C. Z.) measured: head and body, 73.9 mm.; tail, 150.2; ear, 37.8; hind foot, 42.7.

The cranial measurements of the second specimen are: greatest length, 29.6 mm.; basal length, 25.4; palatal length, 15.7; zygomatic width (twice one-half), about 15.2; mastoid width (twice one-half), about 17.4; width across molars, about 6.6; upper cheek teeth, 5.2; lower cheek teeth,—.

Occurrence and Habits.—Until recent years this extraordinary little jerboa was known only from the original specimens taken in Chinese Turkestan. The extension of its range into the Alashan Desert was one of the notable results of Dr. F. R. Wulsin's expedition to the southern borders of that area, and his specimen later became the type of the present race. Meanwhile, however, Vinogradov (1926) was the first to record its presence in the same area, on the basis of four specimens collected August 25, 1924, in Onchi Gurgul on the northern border of Alashan near the frontiers of Tushetu Khan and Sainnoin Khan districts. The same author mentions making a comparison of these with four others from Chinese Turkestan, apparently in the Zoological Museum of the Academy of Sciences at Leningrad, but was unable to satisfy himself that they were subspecifically different, although pointing out that the Gobi specimens had the brain case broader posteriorly, and the tympanic bullæ slightly larger. A. B. Howell in naming this animal as a distinct race also mentions the latter character. In spite of much collecting, the American

Museum Asiatic Expeditions under Dr. R. C. Andrews did not meet with the species, which is probably local in its distribution. Vinogradov in his note adds that "according to the collectors' observations these Gerboas live in sandy valleys covered with low bushes of *Haloxylon ammodendron*. They were observed approaching a pile at a distance closer than four meters and sometimes were found in nomads' huts. One specimen was caught by the collector in a hut during the night and lived in captivity four days showing a strong tendency to bite." Of this lot, one is now in the Museum of Comparative Zoölogy; the collector, V. Kozakevich.

Specimens examined:—One, from Onchi Gurgul, northern Alashan, Inner Mongolia (M. C. Z.).

Genus **Cardiocranius** Satunin

Cardiocranius Satunin, *Annuaire Mus. Zool. Acad. Imp. Sci. St. Pétersbourg*, vol. 7, p. 582, 1902.

A small jerboa, recognizable externally by its five-toed hind foot, of which the outermost toe is about 4 mm. shorter than the fourth, and the innermost or smallest overlies the base of the second toe by about 8 mm. The ears are very short, but of the usual jerboa type, with tubular basal portion. The tail is much constricted at the proximal end, then suddenly expands, to taper gradually to the tip; it is thinly haired, but the hairs become thicker and longer distally to form a small tuft. The audital bullæ and the mastoid area are enormously inflated and globular, giving the skull a nearly heart-shaped appearance from above. The bullæ of opposite sides are not only produced considerably beyond the foramen magnum, but almost touch in the median line, compressing the interparietal between them to a nearly linear bone. In the transverse axis, the lips of the auditory meatuses considerably exceed the zygomata in lateral extent. The upper incisors have each a deep groove, and there is a small premolar in the upper tooth row, giving the formula: $i. \frac{1}{1} c. \frac{0}{0} pm. \frac{1}{1} m. \frac{3}{3} = 18$. The enamel of the first molar seems to consist of a deep outer and a deep inner reëtrant, the former having a sharp forward angle, the latter extending in and back parallel to it. In addition there is a shallow reëtrant at the antero-internal corner so that two inner and two outer lobes are marked off, the outer ones slightly in advance of the corresponding inner ones. The second upper molar is similar but the third is more reduced, with apparently a trace of the antero-internal reëtrant, a well-marked and forwardly running main reëtrant from the inner side and a similar one on the outer side, giving the crown a trifoliate outline. The lower molars are much like the upper, except that the anterior reëtrant is deeper, cutting off with the main inner reëtrant two wide lobes on the lingual side of the tooth, while on the labial side there are three distinct lobes. The second molar is even more developed,

with three inner as well as three outer lobes. The single species, *C. paradoxus*, type of the genus, is as yet known from very few specimens. Satunin figured its skull and jaw, and Vinogradov (1930) has more recently published photographic figures of the teeth as well as outlines of the ear ossicles. In an earlier paper (1925) the latter author has placed this genus in the new subfamily Cardiocraniinæ, which, though probably allied to the Salpingotinæ, is characterized by the possession of five separate instead of partly fused metatarsals and by the simpler structure of the zygomata without the ventral bony projection of *Salpingotus*. Since the characters of the male genitalia are unknown, it was not possible to fit this subfamily into his key based on the comparison of these parts.

459. **Cardiocranius paradoxus** Satunin

Cardiocranius paradoxus Satunin, Annuaire Mus. Zool. Acad. Imp. Sci. St. Pétersbourg, vol. 7, p. 584, text figs. 1-3, 1902.

Type specimen.—An adult male, skin and skull (number not given), in the Zoological Museum of the Academy of Sciences, Leningrad, from Sharagoldschin, Nan Shan, northwestern Kansu, China. Collected in June, 1894, by Roborovski and Kozlov.

Description.—A small, five-toed jerboa with very small ears, thinly haired tufted tail, and enormous audital bullæ. The entire upper parts are grayish buff, the dark-brown tips of the hairs forming a sort of clouding. The hairs of the dorsal region have slaty-gray bases. Outer side of the limbs and the flanks pale ochraceous or rusty-yellow, irregularly washed with dark brown. Outer side of hind limbs ochraceous buff, the hairs with gray bases. Ears gray-brown mixed with darker brown. Soles of the hind feet with a bristle pad of white stiff hairs. The tail, which is incrassated at the base, tapers away to the tip, and is pale brownish, sparsely haired; the under side is white. The hairs are thicker and longer at the tip, forming a small tuft. Under surfaces of body and limbs white to the roots of the hairs.

The enormous enlargement of the auditory region causes the skull to have a somewhat heart-shaped outline as seen from above, with its greatest breadth across the lips of the meatuses instead of across the zygomata. The interparietal seems to be so compressed between the mastoid bones of opposite sides that it is a mere lozenge-shaped ossicle, with a narrow continuation backward between the two bullæ. The tooth pattern, as stated by Satunin, much more resembles that of *Dipus* than of *Euchoreutes*. The lower jaw is characteristic in the deep notch at the angle.

Measurements.—No fresh measurements accompanied the type, but a specimen collected by the Central Asiatic Expeditions measured: head and

body, 60 mm.; tail, 70; hind foot, 27; ear, 5. In the type, a dry skin, the corresponding measurements are: head and body, 73 mm.; tail, 75; hind foot, 25; ear, 6. The skull of the type had a basilar length of 15 mm.

Other dimensions and those of the specimen secured by the Central Asiatic Expeditions follow:

CRANIAL MEASUREMENTS OF *CARDIOCRANIUS*

No.	Greatest length	Basal length	Palatal length	Zygomastic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
(type)	24.5	—	—	12.5	18.5	—	4.0	—	Kansu
84154	22.0	15.8	—	12.0	22.0	—	4.0	3.0	Mongolia

Occurrence and Habits.—Of this very rare species little is known. The type and one other specimen are in the Zoological Museum of the Academy of Sciences in Leningrad, and were collected by Roborovski and Kozlov in June, 1894, although it was not till eighteen years later that their peculiar characters were recognized, and the specimens described as of a new genus. No others were discovered until 1924, when, as recorded by Vinogradov (1926), the Russian explorer V. Kozakevich, who accompanied P. Kozlov on a journey into Mongolia, procured two others in the northern Gobi near Algoikhair Khan Mountain, about five hundred kilometers southwest of Urga, thus greatly extending the known range. Vinogradov compared these with the original specimens but found no important differences. According to the collector, they "were dug out of the burrows which were found among sand-hills covered with *Nitraria schoberi*. Both these specimens lived some time in captivity; they refused whatever vegetable food was offered to them. When they were put together into a box they fought very fiercely, this made it necessary to separate them. The Mongolian name of this Gerboa is 'khoni-alagdaga.'" In addition to these four examples, the only other known specimen is apparently one secured by Dr. Andrews's expedition on May 28, 1925, at Shabarakh Usu in the central Gobi. Nothing further was discovered as to its habits.

Specimens examined.—One, from Shabarakh Usu, Outer Mongolia.

Genus *Dipus* Zimmermann

Dipus Zimmermann, Geogr. Geschichte Menschen u. vierfüss. Thiere, vol. 2, p. 354, 1780. Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 2, p. 307, 1908 (type fixed).
Dipodipus Trouessart, Faune Mamm. d'Europe, p. 207, 1910.

Externally the jerboas of this genus somewhat resemble *Allactaga* in general appearance, but have shorter ears and but three hind toes, the outermost and innermost of the original five having disappeared completely, and the metatarsals of the central three have united to form a cannon-bone. A

prominent stiff brush of hair forms a pad beneath the hind toes, and the long tail ends in a feather-like, flattened tuft. In the fore foot the first digit is a short projecting tubercle without a nail; the third is the longest, the fourth a little shorter, the second still shorter, and the fifth the shortest of the four, all of which are provided with a strong claw slightly curved at its tip for digging. In the skull there is a similar groove roofed over by an inwardly projecting plate at the lower part of the large antorbital foramen. The nasals end proximally in advance of the ends of the premaxillaries in a sort of pit or depression. The auditory region shows a considerable inflation of the bones. The mastoid is enlarged but does not project beyond the occipital level, and the bulla is large and smoothly rounded, rather oval in its long axis, and extends from the condyle forward to the edge of the glenoid cavity of the jaw. The large incisive foramina are narrow and extend back between the first molars. Behind them is a pair of small foramina about midway on the bony palate, which is prolonged beyond the level of the last molars. The hamular processes are about as long as the posterior width of the palate and overlap the inner ends of the bullæ. The incisors are yellow, the upper pair with a prominent median groove. The tooth formula is: $i. \frac{1}{1} c. \frac{0}{0} pm. \frac{1}{6} m. \frac{3}{3} = 18$. The small upper premolar is a mere spicule, about half the height of the first molar, transversely oval in section. The molars are high-crowned, with a different type of enamel pattern from that of *Allactaga*, consisting of a deep reëntrant from the front face of the tooth, with a single deep reëntrant curving backward from the middle of the outer side, thus cutting off two high lobe-like cusps. On the inner side of the tooth a shorter, nearly transverse indentation marks off two other lobes, so that the tooth consists of two outer and two inner alternating lobes. The second upper molar is essentially the same but smaller, while the third is similar but smaller, with the postero-internal lobe so reduced that the tooth appears to consist of two outer lobes and one antero-internal lobe. In the lower jaw the incisor root passes underneath the molar row to the outer side of the condyle, just below which it ends in a small projecting capsule. The first lower molar is much like the upper, with a median deep notch separating two opposite tubercles. A wide, triangular reëntrant in the middle of the outer side separates the anterior from the posterior outer tubercle, and a pair of similar reëntrants on the inner side of the tooth cut off a large anterior tubercle and a very small posterior one at the back of the tooth. The second lower molar has a very shallow anterior reëntrant and a deeper one near the middle on the outer side, cutting off a small antero-external lobe and two large ones. On the lingual side two forward-running indentations, one at the middle and one at the posterior corner of the tooth, form deep valleys separating two large tubercles. The third lower molar is well developed but smaller, and with a similar pattern except that the minute antero-external cusp is lost and the

second reëntrant on the inner side is too small to be obvious after slight wear and hardly cuts off a distinct lobule.

Apparently only a single form of this genus has invaded the desert areas of Mongolia, and, though first made known by Thomas in 1908 as a distinct species, is probably to be regarded as a subspecies of *D. sagitta* of southwestern Siberia. This latter (the *Mus sagitta* of Pallas) is the type of the genus.

460. *Dipus sagitta sowerbyi* Thomas

SOWERBY'S THREE-TOED JERBOA

Dipus sowerbyi Thomas, Ann. Mag. Nat. Hist., ser. 8, vol. 2, p. 307, 1908.

Dipus halli Sowerby, Ann. Mag. Nat. Hist., ser. 9, vol. 5, p. 279, 1920. Chihfeng, Jehol.

Type specimen.—An adult male, skin and skull, No. 8.7.31.2, British Museum, from Yulinfu, Shensi, China, altitude 4,000 feet. Collected April 29, 1908, by Arthur de C. Sowerby.

The type specimen of *Dipus halli* is also in the British Museum, No. 19.12.22.15, an adult female from Chihfeng, Jehol, China.

Description.—Among the series studied, two types of coloration are to be seen. One, possibly a winter coat, is bright ochraceous buff slightly mixed with all-black and black-pointed hairs from the muzzle and forehead along the median area of the back to the base of the tail; laterally the all-black hairs partly disappear, so that the sides of the muzzle, the cheeks below the ears, and the flanks are clear bright ochraceous with a faint dusting of the darker color. The bases of these latter hairs are pure white instead of slaty as over the central area of the body, thus giving an additionally pale effect. A broad pure white hip-stripe includes the base of the tail all around and extends forward nearly across the hip, partly dividing the ochraceous area of the sides. The outer surface of the tibial part of the hind leg is bright ochraceous buff with slaty bases to the hairs in the central part of the area. Ear with the proëctote ochraceous buff, the metentote clothed with white hairs, and the inner base of the ear pure white, forming a distinct spot. Cheeks below the eye white, the upper lips broadly, the forearms, fore and hind feet, and entire ventral surfaces to high up on the flanks, pure white to the bases of the hairs. In the second, and more usual, color phase (possibly representing the summer pelage), the coloring is much paler, a pale sandy buff replacing the brighter tint. An ill-defined whitish spot is present over each eye. The tail is rather sharply bicolor, colored above like the back, except at its extreme base, and at the tip where the longer distichous hairs form a flattened pencil, black at the base, with a white tip. On the under side of this pencil only the edges are black in the basal two-thirds. One or two of the longer vibrissæ extend back nearly to the level of the hips.

The general features of the skull and teeth have been described under the generic characters. The grooved, yellow upper incisors will distinguish specimens at a glance from the species of *Allactaga*.

Measurements.—As in other leaping mammals the tail is longer than the head and body, well tufted. The enormous hind feet are more than a third the length of the tail, with the toe-pads tufted. Ears are shorter than in *Allactaga*. The following measurements are from specimens in the flesh:

No.	Head and body	Tail	Hind foot	Ear	Locality
8.7.31.2 BM (type)	116	169	65	22.0	Shensi
9.1.1.248 BM	110	168	66	21.0	Shensi
9.1.1.241 BM	106	155	65	22.5	Shensi
9.1.1.235 BM	117	150	64	23.0	Shensi
9.1.1.247 BM	115	184	67	22.0	Shensi
16.1.1.12 BM	116	164	64	21.0	Jehol
58521	122	168	63	22.0	Mongolia
58532	120	162	64	21.0	Mongolia
58563	125	156	61	21.0	Mongolia
58580	128	164	62	22.0	Mongolia

CRANIAL MEASUREMENTS OF *DIPUS SAGITTA* SOWERBYI

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
8.7.31.2 BM (type)	34.0	29.0	19.7	21.7	20.8	7.7	6.0	6.4	Shensi
9.1.1.240 BM	33.7	28.7	18.9	22.4	21.5	7.6	6.1	5.8	Shensi
9.1.1.241 BM	33.8	29.6	19.8	21.7	20.7	8.0	6.5	6.0	Shensi
9.1.1.245 BM	32.6	27.8	18.9	21.2	20.7	7.6	5.9	5.7	Shensi
9.1.1.247 BM	33.8	29.6	19.6	22.6	21.7	7.9	6.3	6.0	Shensi
19.12.22.15 BM (type of <i>D. halli</i>)	36.5	31.5	21.5	22.3	21.6	7.9	6.4	6.0	Jehol
16.1.1.12 BM	34.3	29.7	20.5	21.0	21.0	7.5	6.5	6.3	Jehol
19.12.22.14 BM	33.9	29.2	19.2	20.5	19.7	7.7	5.8	6.0	Jehol
58580	32.8	29.0	18.9	22.7	21.0	7.4	6.3	5.8	Mongolia
84127	30.9	27.6	17.9	21.5	19.8	7.8	6.1	6.5	Mongolia

Nomenclature.—As first suggested by Thomas, this is closely allied to *D. sagitta* of western Siberia, though larger. I have therefore regarded it as but an eastern subspecies of that animal, which is also slightly different in color, a more pinkish buff. Having had the privilege of examining the original series of both *D. sowerbyi* from Shensi and *D. halli* from Jehol, I find the two are after all quite identical when individuals in the same pelage are compared; indeed, the types of both are as nearly identical as one might hope to see. According to the labels, both the type and the paratype of *D. halli* were captured in the autumn of 1915 in Jehol, and kept in captivity until their death in December of the following year. They are thus presumably in winter pelage, which is a

mixed buffy and black above, producing a sandy gray. The third individual is in the brighter buffy phase, but has been moulting in an irregular manner. The possibility is suggested that the true winter pelage is the more brilliant ochraceous buff and the summer pelage the more sandy. Specimens taken in April show both conditions.

Occurrence and Habits.—Although unrecorded from Mongolia until Thomas in 1908 described it as a new species, this jerboa is apparently common over the length and breadth of the central Gobi. The original series from Yulinfu and thirty miles to the west in the Ordos Desert perhaps represents a southerly outpost of the general range. Sowerby (Clark and Sowerby, 1912, p. 183) writes that here their food "seems to be delicate shoots and seeds of such scrubby plants as can find sustenance in the arid desert." On his explorations in the central Gobi, Dr. R. C. Andrews found it common at a number of localities where trapping was done, such as at Sair Usu, Iren Dabasu (Erhlien), Tsagan Nor, Loh, Tuerin and Shabarakh Usu. At Iren Dabasu he found it to outnumber *Allactaga*, whereas at Tuerin the latter was by far the more abundant. Tuerin he believed to be near the northern limit of its range in the Gobi. Most of the series taken were collected in April and May, and again in late July to September, but, strange to say, no young animals were among them. Possibly they had not yet ventured afield in the early part of the season. Vinogradov and Argyropulo (1931) have published some excellent photographs of this species in life, showing the characteristic manner of sitting partly erect on the hind feet, with the long tail bowed upward in its basal three-fourths while the broad hair tuft at the end rests flat upon the ground like the third leg of a tripod. The figures are of typical *D. sagitta*. Other views show the sand deserts with scattered clumps of vegetation in the hollows, amongst which the species lives. Howell quotes Sowerby's notes on live individuals in captivity that they slept during the day so soundly that they could be picked up and handled without being awakened. They are "frugal" eaters, merely nibbling at vegetables or grain. A new species of flea, *Neopsylla compar*, was described from the Yulinfu series by Messrs. Jordan and Rothschild.

Specimens examined.—The following one hundred and ninety-one:

China:

Jehol: Chihfeng, 3, the type and topotypes of *D. halli* (B.M.).

Shensi: Yulinfu, 20, including the type (B.M.), 1 (M.C.Z.); thirty miles southwest by south of Yulinfu, 1 (B.M.).

Mongolia:

Sair Usu, 9; fifty miles west of Sair Usu, 1; one hundred and sixty miles southeast of Sair Usu, 16; Iren Dabasu (or Erhlien), 60; Tsagan Nor, 44; forty-five miles east of Tsagan Nor, 1; Loh, 1; Tuerin, 5; ten miles north of Artsa Bogdo, 2; Shabarakh Usu, 23; eighty miles west of Bailing Miao on the Hami road, 4.

Genus *Stylodipus* G. M. Allen*Stylodipus* G. M. Allen, Amer. Mus. Novitates, no. 161, p. 4, 1925.*Scirtopoda* Vinogradov, Bull. Acad. Sci. URSS, cl. sci. phys.-math., ser. 7, 1930, p. 462 (in part).

Externally much resembling *Dipus*, the fore feet with a blunt knob-like thumb provided with a small flattened nail, the other four fingers with nearly straight claws, the third and fourth subequal, the second and fifth likewise of about equal length and shorter than the other two. Hind foot shorter in proportion than in *Dipus*, with but three digits (the second, third and fourth), of which the central one is longest, each with a short stout claw hidden by projecting stiff hairs. Sole of the hind foot hairy, developing a brush-like pad beneath the toes. Ears shorter and more rounded than in *Dipus*. Tail cylindrical for the basal half, covered with short appressed hairs which, in the distal half or more, gradually increase in length to form a distichous terminal brush about three times the width of the basal shaft. There is no distinct white tip. The skull has the mastoid region much inflated, and produced some 2 mm. behind the level of the occipital plane, while the bullæ nearly touch at their antero-internal angles, and slightly overlap the glenoid cavity of the jaw. The interparietal, instead of being pentagonal as in *Dipus* and *Scirtopoda*, has more the shape of a calyx in side view, with a wide anterior margin produced lip-like at each side, a short posterior border parallel to this, and an outwardly curved lateral edge. The ascending branch of the jugal is very broad and forms a projecting angle half-way up on its posterior side. The rostrum is relatively longer than in *Scirtopoda* and there are, in addition to two small oval vacuities in the middle of the palate, one or two similar perforations at the level of the last molar. The teeth comprise an additional minute premolar which is lacking in *Scirtopoda* but well developed in *Dipus*. The tooth formula is therefore: $i. \frac{1}{1} c. \frac{0}{0} pm. \frac{1}{1} m. \frac{3}{3} = 18$. The incisors are white, the upper ones each with a median groove. The upper pair in profile are placed about vertically or a trifle recurved. The lower are shorter than in *Allactaga*, and pass beneath the front of the molar row to a projecting capsule just external to the head of the condyle and slightly below it. There is the usual fenestra in the angular process of the jaw. The upper molars are simple in pattern, having each a single reëtrant from inner and outer sides, of nearly equal depth, the outer minutely the deeper, and touching the reëtrant of the opposite side just behind its tip, thus forming a figure-8. The third molar has the posterior loop smaller than the anterior, with a shallower inner reëtrant, so that the loop is larger on the outer than on the inner side. The lower molars are essentially similar, except that the first has an infold of enamel from the anterior margin.

The mammæ are eight, one pair pectoral but far forward in front of the axillæ, the second pair about in the middle of the thorax, and two pairs inguinal.

Among other Mongolian jerboas now known, this genus may be at once

recognized by its tail, which has no definite tuft of black hairs and a white tip, but instead the hairs gradually increase in length in the terminal half, forming a flat feather, concolorous with the back. The relationship of this genus to *Scirtopoda* is no doubt close, and it may be regarded probably as the Asiatic representative of the African animal. Indeed, in his recent paper, "On the classification of Dipodidæ," Vinogradov (1930) unites it with *Scirtopoda*, believing the presence of the vestigial premolar in *Stylodipus* an unimportant character. The type of *Scirtopoda* was fixed by Thomas (1908) as *Dipus mauritanicus* Duvernoy of Algeria, which is an animal without the upper premolar, with a very differently shaped interparietal (pentagonal), and of a different type of coloring. Vinogradov, in reaching this decision, evidently made comparison only with "*Scirtopoda*" *telum* of western Asia and eastern Europe, which I would include in *Stylodipus* on the strength of the three characters mentioned, while admitting that the differences may eventually be regarded as insufficient for generic distinction.

The type of the genus is *Stylodipus andrewsi* G. M. Allen, which I would now place as a subspecies of *telum*. It is the only form now known from the area here covered.

461. *Stylodipus telum andrewsi* G. M. Allen

ANDREWS'S FEATHER-TAILED JERBOA

Stylodipus andrewsi G. M. Allen, Amer. Mus. Novitates, no. 161, p. 4, 1925.

Scirtopoda andrewsi Vinogradov, Bull. Acad. Sci. URSS, cl. sci. phys.-math., ser. 7, 1930, p. 462.

Type specimen.—An adult male, skin and skull, No. 58549, American Museum of Natural History, from Uskuk, Mongolia. Collected June 22, 1922, by the Central Asiatic Expeditions under Dr. R. C. Andrews.

Description.—In general appearance much like *Dipus sagitta sowerbyi*, but at once distinguished by the shorter ears and hind feet, and by the plume-like tail carrying the mixed buffy and black colors of the back, instead of having a sharply defined flat tuft, black with a white tip. The entire dorsal surface, including head, ears, central area of the back, and the outer side of the hind legs to the ankle, sandy-colored or pale buff, slightly and evenly darkened with black-tipped and all-black hairs. Over the central area the hairs are "deep neutral gray" at base, tipped with "light ochraceous buff" and often a minute black point. Laterally the colors pale, and along the flanks the hairs become white-based with bright buffy tips. An indistinct whitish spot is present above the eye and a slightly buffy area below it. A small tuft of silky white hairs clothes the inside of the ear at its base, and there is an indefinite post-auricular whitish patch. Upper sides of forearms white at the roots of the hairs, washed with buffy. A stripe running across the posterior part of the hip, and the entire ventral surface of the body, as well as the upper lips and the backs of

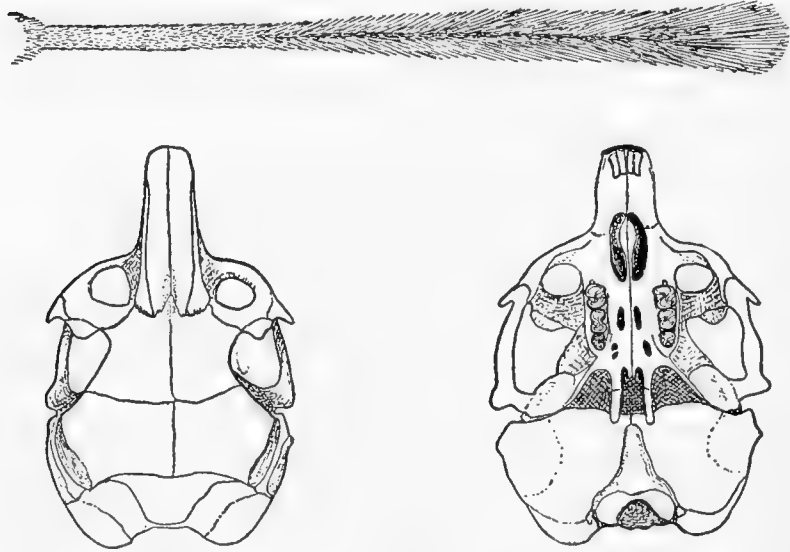


FIG. 57. *Stylodipus telum andrewsi*. Dorsal aspect of the distichous tail (four-sevenths natural size); and dorsal and ventral views of the cranium of the type (one and one-half times natural size).

fore and hind feet, are white to the roots. Soles of the hind feet dark brownish. The tail is white all around immediately at the base, beyond which it is colored much like the back, the dusky tips of the hairs becoming longer near the extremity, and forming an indistinct smoky border to this member, with a few paler hairs medially. The under side of the tail is whitish in the basal half, buffy in the terminal half, with a blackish-brown edging to the last 50 mm. or so.

The chief characters of the skull have already been mentioned. The great inflation of the posterior part of the bullæ and mastoid results in a corresponding compression of the occipital and an alteration of the shape of the interparietal from a pentagonal bone with two sides forward and three behind the posterior border of the parietals to a calyx-like outline, with the anterior border slightly concave backward, and the lateral wings attenuate. The lachrymal is small and subtriangular. The zygomatic arches are rather weak, and are equaled or exceeded in lateral extent by the lips of the auditory meatuses. In profile view the ascending arm of the jugal is seen to be unusually wide, with a blunt triangular process projecting back from half-way on its height. The nasals about equal in posterior extent the ends of the premaxillaries, but their joint outline is notched at the proximal end which lies in a shallow depression. The teeth have been described under generic characters.

Measurements:—Compared with *Stylodipus telum* from southeastern Russia, this is a larger as well as slightly paler animal. The following field measurements are from fresh specimens as taken by the collector:

No.	Head and body	Tail	Hind foot	Ear	Locality
58548	130	145	56	16	Mongolia
58549 (type)	128	150	55	16	Mongolia
58551	125	146	55	17	Mongolia
58552	125	150	53	18	Mongolia
58553	127	144	59	18	Mongolia
58621	120	145	55	18	Mongolia
58624	125	145	56	17	Mongolia
58637	130	140	54	15	Mongolia
58638	120	150	54?	18	Mongolia
58648	122	144	51	16	Mongolia

In specimens from Sarepta and Kirghiz steppes representing typical *S. telum*, the hind foot does not exceed 50 mm. in length, and the skulls also are considerably smaller with less inflated bullæ.

CRANIAL MEASUREMENTS OF *STYLODIPUS TELUM ANDREWSI*

No.	Greatest length	Basal length	Palatal length	Zygo-matic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
58549 (type)	33.0	—	19.0	22.8	22.0	7.4	6.0	6.0	Mongolia
58617	32.0	27.9	18.1	22.1	21.7	7.6	5.8	5.6	Mongolia
84136	33.8	28.4	18.8	22.5	23.1	7.7	5.4	5.8	Mongolia

Occurrence and Habits.—The discovery of this jerboa in the Gobi of Mongolia is due to Dr. Roy Chapman Andrews's work. It is closely related to the more western "*Scirtopoda*" *telum*, which I believe to be generically distinct from

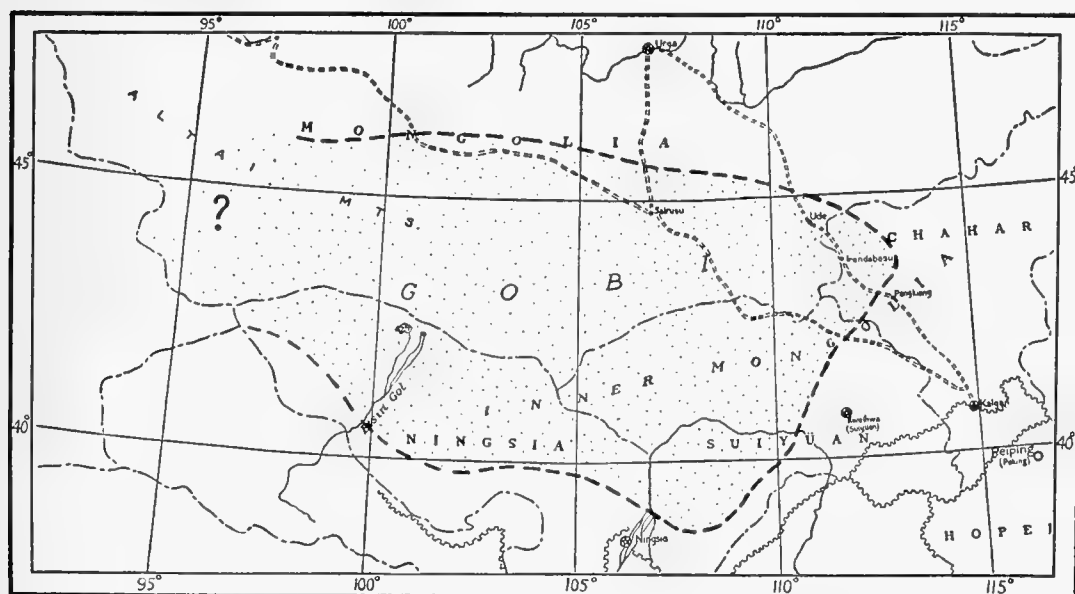


FIG. 58. Distribution Map.
Stylodipus telum andrewsi

S. mauritanicus, the type species of the genus. Its flat, pennate tail, of practically the same color throughout, at once distinguishes it from other Mongolian jerboas. Dr. Andrews secured a number of specimens at points in the Gobi where collecting was carried on, as at Uskuk, Tsagan Nor, Tuerin, Gun Burte, Shabarakh Usu, and as near the border of northern Shansi as one hundred and sixty miles northwest of Paotowchen. Dr. Andrews writes that at Uskuk he caught this species on gravel plains by night, once in a trap set in a ground squirrel's hole. At Loh it was "fairly abundant on the gravel and sand plains," but nothing very definite was learned about its habits.

Specimens examined.—The following twenty-nine:

Mongolia: Uskuk, 9; Tsagan Nor, 6; Loh, 2; Tuerin, 2; Gun Burte, 1; twenty-three miles south of Iren Dabasu (Erhlien), 2; Shabarakh Usu, 2; eighty miles west of Bailing Miao on the Hami trail, 2; one hundred and sixty to two hundred miles northwest of Paotowchen, 3.

Genus *Salpingotus* Vinogradov

Salpingotus Vinogradov, in P. K. Kozlov, Mongolia and Amdo, p. 540, pls. 1, 2, 1922 (separate); Zool. Anzeiger, vol. 61, p. 152, 1923.

Three species of this remarkable genus have been described by Vinogradov, two of them from Mongolia and a third from (probably) Afghanistan. They are therefore apparently characteristic of the great central desert area of Mongolia and Turkestan, although very few specimens are as yet known. In the account of the second species Vinogradov (1923) summarized the generic characters as follows: hind foot with but three toes, their metatarsals not ankylosed; audital bullæ enormous as in *Cardiocranium*; zygomata broad in their anterior (maxillary) portion, with a ventral process arising at the posterior tip of the latter and directed obliquely downward; jugal not reaching the lachrymal; the squamosal with a long and broad anterior process covering the orbital border of the frontal; antorbital foramen relatively narrower than usual; bony palate extending well posterior to the molars; hamular processes very short; a short, horizontal process arising on the outer side of the jaw between the angle and the condyle. Upper incisors ungrooved; dental formula: $i. \frac{1}{1} c. \frac{0}{0} pm. \frac{1}{0} m. \frac{3}{3} = 18$. There are four pairs of mammae, of which the most anterior is almost on the neck, the second pair farther back, and the two other pairs inguinal. In his paper of 1925 Vinogradov has erected the subfamily Salpingotinæ for the dwarf jerboas of this genus, based on the characters of the penis which is slender and tapering without the backwardly projecting spines or scales of the Allactaginæ or the Dipodinæ, while in addition, the baculum, as in the former group, is absent. The same author in his paper of 1930 has published photographic illustrations of the molars, showing that in the enamel pattern there is a certain resemblance to that of *Pygeretmus*.

The two species known from Mongolia may be distinguished as follows:

KEY TO MONGOLIAN SPECIES OF *Salpingotus*

- A. Tail longer and regularly tapering, about 125 mm. long; ventral process of zygomatic arch longer, extending posterior to the opening for the optic nerve *S. kozlovi*
 B. Tail shorter, swollen at base, about 95 mm. long; ventral process of zygomatic arch not extending posterior to opening for optic nerve. *S. crassicauda*

462. *Salpingotus kozlovi* Vinogradov

KOZLOV'S DWARF JERBOA

Salpingotus kozlovi Vinogradov, in P. K. Kozlov, Mongolia and Amdo, p. 540, pls. 1, 2, 1922; Bull. Acad. Sci. URSS, cl. sci. phys.-math., ser. 7, 1930, pp. 460 ff., pl. 7, figs. 4, 17; pl. 8, fig. 13; pls. 9 and 10, fig. 6.

Type specimen.—An adult male in spirit, (number not given), in the Zoological Museum of the Academy of Sciences, Leningrad, from near the ruins of Khara Khoto, central Gobi, Mongolia. Collected May 22, 1909, by P. K. Kozlov.

Description.—The color characters are not given in the English résumé following the original description (in Russian), but are said elsewhere to be sandy above, with gray bases to the hairs, becoming lighter on the sides and pale yellowish on the belly.

The skull, as figured by the describer, shows many unusual features. The enormous bullæ project far behind the occiput but do not touch each other, leaving a narrow slit between their projecting spheres. The proximal portion is equally swollen, so that the interparietal is reduced to a very narrow sliver of bone between their anterior ends. In side view the greatly inflated meatus

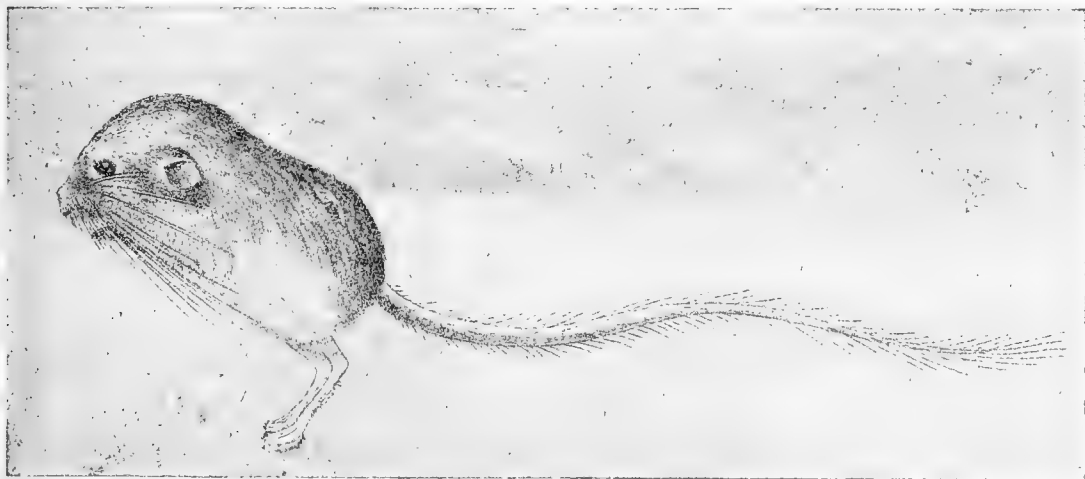


FIG. 59. Kozlov's Dwarf Jerboa (*Salpingotus kozlovi*). Courtesy of Dr. B. S. Vinogradov, del. About one-half natural size.

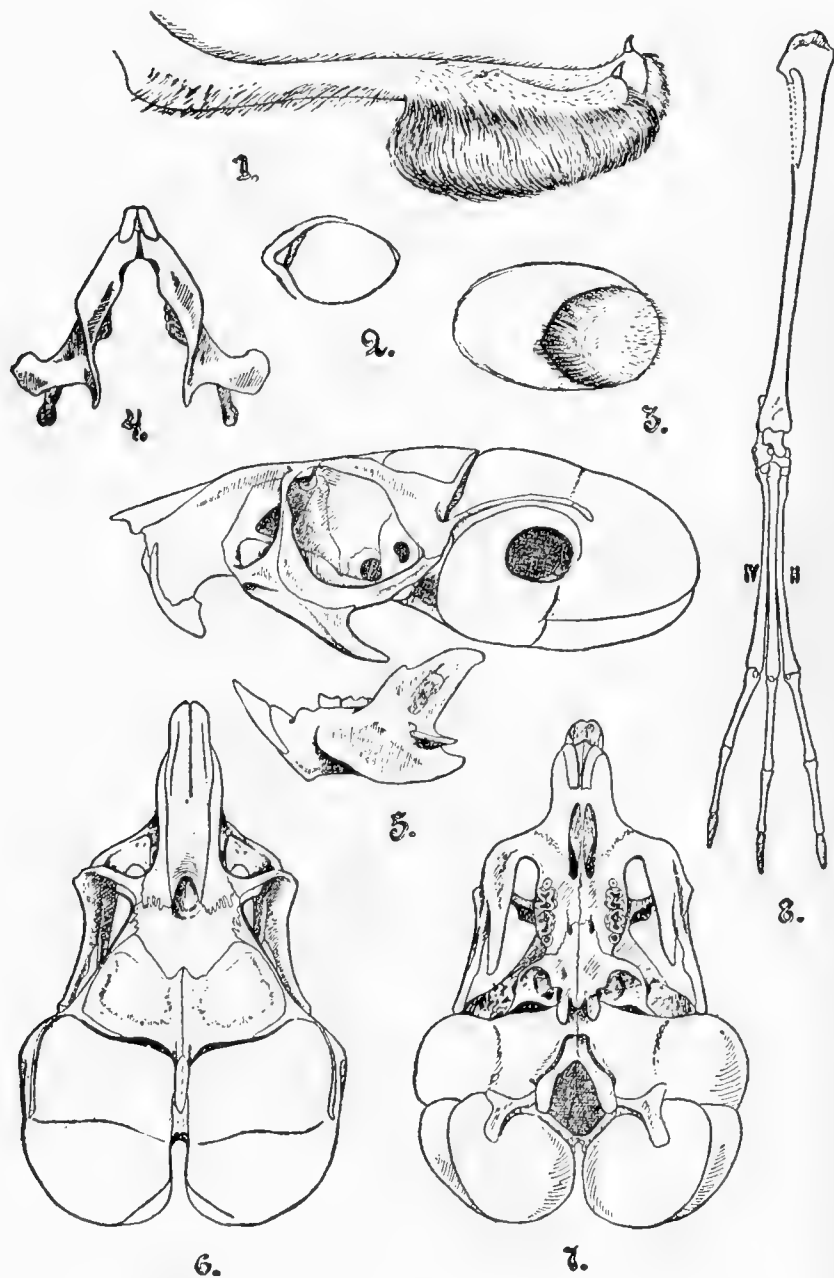


FIG. 60. *Salpingotus kozlovi*. 1, hind foot, showing pad of stiff hairs; 2, eye; 3, ear; 4, lower jaw from below; 5, side view of skull and jaw; 6, dorsal view of skull; 7, ventral view of skull; 8, tibia and foot bones, anterior view. All figures more than twice natural size. Courtesy of Dr. B. S. Vinogradov, del.

extends forward as far as the glenoid cavity of the jaw. The squamosal bone sends out two narrow processes, a posterior which forms a slender tongue projecting backward over the auditory meatus, and an anterior slightly wider

tongue that passes forward along the upper edge of the orbit to touch the lachrymal bone. A characteristic of the genus is the hook-like ventral projection of the maxillary process of the zygomatic arch, which in this species extends back beyond the level of the optic foramen. The mandible is short, heavy and broad in side view, with a minute coronoid process and a projecting external shelf-like plate between the condyle and the angle.

The premolar and the last molar of the upper jaw are small and circular in section. The enamel pattern of the first larger upper molar consists of a pinching-in of the enamel wall at the front end of the tooth on both sides, making a small median anterior lobe. About at the middle of the tooth's length is an infold of enamel on both sides, the two almost opposite, and resulting in a nearly figure-8 pattern. The second upper molar is more nearly a figure-8, without the anterior median lobe. In the lower jaw the pattern is practically the same (see Vinogradov, 1930, pls. 9 and 10, fig. 6). The skeleton of the hind leg shows the fibula reduced and thoroughly fused to the tibia, while the three metatarsals are nevertheless all separate.

Measurements:—The type specimen, in spirit, measured: head and body, 51 mm.; tail, 126; hind foot, 25.2; ear, 11.8; external opening of ear, 7.3; tail tuft, 18. Its skull measured: greatest length, 27.4 mm.; condylobasal length, 22.0; zygomatic width, 13.5; mastoid width, 17.5; interorbital constriction, 5.4; height of brain case, 7.9; nasals, 10.8; diastema, 4.8; length of mandible, 12.1; upper cheek teeth, 3.8; lower cheek teeth, 3.2.

Occurrence and Habits:—Since the original discovery of this remarkable dwarf jerboa at Khara Khoto, central Gobi, Mongolia, only one other specimen has been taken. This was an adult female from the same locality collected by P. Kozlov, July 7, 1926 (Vinogradov, 1926). The mammae in this individual were said to be but six, with only one pair pectoral, but possibly this is an individual variation, for in *S. crassicauda* there are eight. The tip of the tail with its pencil was lost, yet the length of the tail was 112 mm. without it, indicating that it must originally have been about as long as in the type. "This wonderful little animal seems to be very rare in Mongolia; all efforts to find it were unsuccessful for a long time but at last the expedition succeeded to catch one specimen." Although nothing is recorded of its habits or habitat, it seems to be a species of the sandy wastes.

Specimens examined:—None.

463. *Salpingotus crassicauda* Vinogradov

THICK-TAILED DWARF JERBOA

Salpingotus crassicauda Vinogradov, Zool. Anzeiger, vol. 61, p. 150, text figs. 1-5, 1923.

Type specimen:—An adult female (?skin and skull), No. 13257, Zoological

Museum of the Academy of Sciences, Leningrad, from near Shara-in-Sumu, Gobi Altai, about one hundred and sixty kilometers south of the Russo-Mongolian border. Collected in the summer of 1914 by V. Kuzmin.

Description.—Distinguished from *S. kozlovi* by the much shorter tail which in its basal portion is incrassate or evenly swollen in appearance, on account of a thick deposit of fat covering the vertebræ; beyond the basal third it tapers evenly to the tip. Its surface is covered with short hairs which even at the tip are only slightly longer than elsewhere. In color and general external characters this form is otherwise similar to the longer-tailed species.

The skull is smaller and relatively shorter than in the latter, with the bullæ enormously enlarged and even further compressing the interparietal, so that it seems to have entirely disappeared, and the bullæ are separated dorsally by an almost linear space. Zygomata narrower than in *S. kozlovi*, and the hook formed by the posterior projection of the maxillary process shorter, barely reaching the level of the optic foramen. The anterior process of the squamosal, which in the latter species extends forward along the frontal border to abut against the lachrymal, is in this species less developed and does not quite reach that bone. The mandible is smaller and less heavily built, with the additional external process between condyle and angle smaller, shorter and narrower. A small foramen perforates the angular part of the jaw. "Teeth essentially as in *S. kozlovi*, but smaller."

Measurements.—The type and only known specimen measured: head and body, 41 mm.; tail, 93.2; hind foot, 20.5; ear, 5.6.

Cranial measurements of the type as published by Vinogradov are: greatest length, 22.7; condylobasal length, 18.1; zygomatic width, 11.6; inter-orbital constriction, 4.6; width across meatuses, 16.4; depth of brain case, 7.2; nasals, 8.1; diastema, 4.2; length of mandible, 9.7; upper cheek teeth, 3.0; lower cheek teeth, 2.4.

Occurrence and Habits.—As yet this dwarf jerboa is known only from the unique type specimen from near Shara-in-Sumu in the Gobi Altai, about one hundred and sixty kilometers south of the Russo-Mongolian border. It was originally in the Barnaul Museum, western Siberia, but is now in the collection of the Academy of Sciences at Leningrad. It seems to be well characterized by its shorter and incrassated tail, the complete loss of the interparietal, and the shorter anterior process of the squamosal, as well as by the shorter ventral process of the zygomatic arch. Nothing further is known of this remarkable animal, but the possession of the thick, brush-like pad of hairs beneath the hind toes indicates sand-living habits.

Specimens examined.—None.

SUPERFAMILY HYSTRICOIDEA

PORCUPINES AND THEIR ALLIES

In Miller and Gidley's classification of the rodents this major division is more or less equivalent to the Hystricomorpha of most recent authors. As in the Dipodoidea, the dorsal bridge of the antorbital foramen is large and forms the lateral portion of the opening, while the part corresponding to the vertical zygomatic plate in the squirrels and rats is again ventral and narrow. The chief characteristic pointed out by the two authors mentioned is that the masseter medialis arises along the side of the rostrum, and is a large muscle, passing through the enlarged antorbital foramen. The latter shows no special provision for roofing over the branch of the fifth nerve which also passes through it, but there may be a slightly countersunk gutter for its reception. There is an upper premolar and a lower, making four teeth above and four below. The group is chiefly represented in South and Central America by many large and small forms of a number of genera, but seems to have died out to a large extent in the Old World. In China there is but a single family, that containing the porcupines, Hystricidæ, with a few species of subtropical and south temperate distribution.

Family HYSTRICIDÆ

PORCUPINES

This family includes the Old World porcupines of several genera. They have in common a tendency to the inflation of the nasal chamber, most pronounced in *Hystrix*, and the angle of the jaw not deflected outward nor produced back of the condyle but a vertical plate set considerably to the outer side of the axis of the molar row. The jugal bone forms the middle portion of the zygomatic arch. The frontal portion of the skull is large, exceeding the parietal portion. The cheek teeth are four above and four below on each side, all of practically similar structure, with a pattern due to the wearing down of infolds of enamel from the labial side in the upper teeth and from both sides in those of the lower jaw. Two subfamilies are defined by Miller and Gidley, both of which occur in China. The more primitive is the Atherurinæ, including the brush-tailed porcupines, in which the base of the upper zygomatic root is over the front end of the tooth row, the cheek teeth are distinctly rooted and there are but three sacral vertebræ. The other subfamily, the Hystricinæ, has the base of the upper zygomatic root "decidedly behind the anterior extremity of the tooth row," the teeth are higher crowned, "closed at base but without definite roots," and there are four sacral vertebræ. In the Atherurinæ the tail is relatively long and the body less stout, but in the Hystricinæ the tail is very

short, the specialization of the quills is greater and the body is stout and heavy. The two genera occurring in China may thus be told as follows:

KEY TO THE GENERA OF CHINESE HYSTRICIDÆ

- A. Tail more than twice the length of hind foot, scaly with a tuft of small capsulate bristles; longest spines of back about 75 mm., nasals only slightly (3-4 mm.) exceeding the ends of the premaxillæ in posterior extent..... *Atherurus*
- B. Tail less than twice the length of hind foot, stumpy, with a few enlarged capsulate quills; longest spines of the back much more than 75 mm.; nasals about half again as long as the premaxillæ..... *Hystrix* (*Acanthion*)

Genus *Atherurus* F. Cuvier

Atherurus F. Cuvier, Dictionnaire des Sci. Nat., vol. 59, p. 483, 1829.

The brush-tailed porcupines, in addition to the characters already discussed, have a proportionately long body, short, stout limbs, and a scaly tail with at its tip a brush of stiff bristles, each of which has three or four small capsular enlargements of about the size of a rice grain in its terminal half. The ears are short and rounded, the claws stumpy and little curved. The coat is almost entirely spiny, the spines of the mid-dorsal area being the longest, most of them flattened and grooved above, but with a few slender cylindrical quills projecting above them. The skull is notable for the wide interorbital space and the great proportionate size of the frontals which occupy about the middle third of the cranium, but show only a slight indication of inflation, with a nearly flat upper surface. The upper tooth rows diverge anteriorly and have each four cheek teeth as do also the lower rows. The dental formula is: $i. \frac{1}{1} c. \frac{0}{0} pm. \frac{1}{1} m. \frac{3}{3} = 20$. The cheek teeth of the upper jaw are nearly circular in section, with a pattern consisting of three deep outer reëntnants extending nearly across to the opposite enamel wall, and varying in level individually, so that with slight wear parts of them become cut off as small enamel islets, giving the tooth a complex pattern at first sight. In the lower jaw the incisor runs back below the level of the anterior cheek teeth to a point below the coronoid process, but its root does not form a projecting capsule, and the angle of the jaw is vertically placed, just external to the curvature followed by the root. The lower cheek teeth are alike in essential structure, with a somewhat figure-8 shaped outline formed by the deep vertical infolding of enamel from the middle of both labial and lingual borders. In addition to these main infoldings there are one or two others of less vertical depths, which leave small islets of enamel in the center of the crown with slight wear.

The brush-tailed porcupines show an interesting distribution, for they occur in the forested country of western and central Africa, and again, after

an intervening break, in the oriental forests of India, Malaysia and southern China, for, although mainly a ground-living animal, they can also climb fairly well. No doubt this distribution is an ancient one, indicating a time when formerly there was more or less continuous forest across from the Congo to the east coast of Asia. Two races of this porcupine are accredited to southern China, one on the mainland and a slightly differentiated insular race on Hainan.

464. *Atherurus macrourus stevensi* Thomas

Atherurus stevensi Thomas, Proc. Zool. Soc. London, 1925, p. 505.

Atherurus macrourus stevensi G. M. Allen, Amer. Mus. Novitates, no. 290, p. 1, 1927. Osgood, Publ. Field Mus. Nat. Hist., zool. ser., vol. 18, p. 326, 1932.

Type specimen.—A female, skin and skull, No. 25.1.1.93, British Museum, from Ngai Tio, Tongking, French Indo-China. Collected June 8, 1924, by Herbert Stevens for whom it was named.

Description.—This race is described by Thomas as having a lighter belly than in typical *A. macrourus* of Malacca, with whitish wool-hairs among the bases of the spines on the back, particularly over the shoulders, whereas in the latter these hairs are fewer and brownish. The general color of the top and sides of the head, neck, fore and hind limbs is light chocolate brown, nearly clear. On the flanks and continuing as a band across the hips, however, the individual flattened spines are whitish with a band of pale chocolate brown below the white point, which gives these areas a mixed brownish and white appearance. The center of the throat, except the brownish chin, the mid-ventral area and the inner sides of the fore and hind legs are white to the bases of the spines. The mid-dorsal area has the longest spines, which are for the most part black in the distal half, paling to dark brown at base, flattened and dorsally grooved, attaining a length of some 75 mm. Interspersed among these, and of about the same length, are a few long slender whitish quills with brown bases, not flattened but cylindrical. The tassel of terminal hairs on the tail, with their capsular inflations, is whitish.

The skull, according to Thomas, differs from that of the typical race in having the profile from the crown to tip of nasals practically straight instead of convex or inflated, and the muzzle more slender, with the nasal bones longer and narrower, less square.

Measurements.—The type specimen of *A. stevensi* measured in the flesh: head and body, 525 mm.; tail, 228; hind foot, 75; ear, 36. The skull measured: greatest length, 102 mm.; condylo-incisive length, 95; zygomatic width, 50; mastoid width, 34.7; length of nasals, 29.5, width, 15.5.

Occurrence and Habits.—I have provisionally referred the brush-tailed porcupine of the Chinese mainland to the race *A. m. stevensi*, but Osgood (1932)

has described a certain amount of variation in the color and in the amount of the white under-hair among the spines in specimens from northern Tongking, which indicates that the characters upon which *A. m. stevensi* was based may be subject to more variation than was supposed, so that it is still a question as to how different the northern animals are from the typical *A. macrourus* of Malacca. This is a species of subtropical distribution, which appears to be rare in southern China on the mainland. Only a single specimen, with skull, was secured by the Central Asiatic Expeditions—a male from Wanhsien, eastern Szechwan, February 10, 1923. It was brought in to Dr. Granger by a native but no details of its capture are available. Sowerby (1929d) has given a brief account, with an excellent photograph, of a tame one, apparently from the same province. The view shows the tail carried up over the back when the animal is at rest. The food is said to be roots, tubers, and the green parts of various plants. There appear to be no other definite records for southern China, although it must occur sparingly over much of the southern border.

Specimens examined:—One, from Wanhsien, Szechwan.

465. *Atherurus macrourus hainanus* J. A. Allen

HAINAN BRUSH-TAILED PORCUPINE

Atherurus hainanus J. A. Allen, Bull. Amer. Mus. Nat. Hist., vol. 22, p. 470, 1906; *ibid.*, vol. 26, p. 239, 1909.
Atherurus macrourus hainanus G. M. Allen, Amer. Mus. Novitates, no. 290, p. 1, 1927.

Type specimen:—An old adult (?sex), skin and skull, No. 26641, American Museum of Natural History, from the island of Hainan, China. Collected in September, 1902, by agents of Alan Owston.

Description:—This island race is characterized by being "smaller and darker in color, with shorter spines and a much shorter tail" than the typical race of Malacca. With that modification, the description of color given for *A. m. stevensi* will in general apply to it, although Thomas believed that the latter is slightly paler above and much lighter below than the Malayan *A. m. macrourus*. Osgood (1932), however, from an examination of a number of specimens from Tongking, seems to have found considerable variation in the degree of dark coloring, so that the value of these color differences is uncertain. In the Hainan race the coloring may vary from the more usual blackish in the mid-dorsal area, with chocolate head and paler sides, to a distinctly pale rufous as later recorded by J. A. Allen (1909, p. 239).

The skull, according to the latter author, is in general like that of *A. m. macrourus* but "the malar has less anterior extension." He adds, further, that in size it nearly agrees with the insular *A. zygomaticus* from Pulo Aor, but has a narrower zygoma and larger lachrymal.

Measurements:—Unfortunately no fresh measurements of adults are available. The type, as made up into a skin, measured: total length, 520 mm.; head and body, 381; tail, 139; hind foot, 64; ear, from notch, 30. A young individual measured by Mr. Clifford H. Pope gave the following: head and body, 180 mm.; tail, 80; hind foot, 38; ear, 20. The proportions are therefore much the same in these two, with the tail about twice the length of the hind foot or slightly more.

CRANIAL MEASUREMENTS OF *ATHERURUS MACROURUS HAINANUS*

No.	Greatest length	Basal length	Palatal length	Zygomat-ic width	Mastoid width	Width outside premolars	Upper cheek teeth	Lower cheek teeth	Nasals	Locality
59982	89.0	79.0	44.0	41.5	31.0	17.0	15.3	16.4	23.7	Hainan
59983	94.0	83.0	46.0	42.5	33.0	17.5	16.0	16.6	24.6	Hainan
59985	91.0	82.0	45.5	45.0	32.5	19.5	15.2	16.5	26.2	Hainan
60043	92.5	79.4	44.5	44.7	31.6	19.5	15.5	16.0	23.6	Hainan
60045	87.0	76.5	41.2	41.5	32.0	17.2	16.0	16.7	22.0	Hainan
60046	93.4	83.0	46.0	44.5	34.0	19.2	13.6	15.5	25.2	Hainan
60051	91.0	79.5	44.5	45.0	32.0	18.0	15.6	15.8	25.0	Hainan
60052	94.0	85.0	48.0	43.8	32.0	20.0	16.5	17.0	27.0	Hainan

Occurrence and Habits:—This porcupine was unrecorded from Hainan until 1906 when the late Dr. J. A. Allen described it on the basis of a single specimen secured in the island by collectors working for Alan Owston of Yokohama. Nevertheless it is apparently not uncommon in the uncleared areas, but very little information is at hand as to its habits. Mr. Clifford H. Pope, who in 1923 secured eighteen specimens, old and young, writes that he bought nearly all of them from a single native hunter at Nodoa. "Every day or so he would come in with one or two or even three. Some of them had evidently been smoked or burned out, as evidenced by their singed whiskers. On the side of a hill covered with a dense mass of bushes and high grass I found a network of well-worn little paths which my hunter declared to be runs of the porcupine, but I am not sure which kind he meant." According to the Chinese hunters employed by Mr. Pope, these porcupines make holes among the roots of trees or under banks of streams, and a single series of the connecting burrows may hold two or three individuals. They appear to avoid steel traps. The youngish specimen, of which the measurements were given above, was taken April 13, but all the others, adults or well grown individuals, were brought in during January.

Specimens examined:—Eighteen, from Nodoa, island of Hainan.

Genus *Hystrix* Linnæus

Hystrix Linnæus, Syst. Nat., ed. 10, vol. 1, p. 56, 1758. Lönnberg, Arkiv f. Zool., Stockholm, vol. 15, no. 18, 1923.

Acanthion F. Cuvier, Mém. Mus. d'Hist. Nat., Paris, vol. 9, pp. 424, 425, 431, 1822 (as a subgenus).

The large Old World porcupines are much in need of a general and critical study with ample material, in order to determine the limits of generic and specific characters. In external appearance all are much alike, of stout heavy build, short tail, broad feet, and an extravagant development of the pelage whereby the hair of the anterior part of the body becomes quilly and that over the back develops into long, stiff, pointed spines for defensive purposes, while mixed among these are longer and more slender quills. The stumpy tail bears a number of specialized quills which have a slender stem, then expand into an open-ended tube or capsule. These and the other large quills are vibrated when the animal is disturbed, and produce a menacing rattle. The mammae are two, one on either side of chest, rather high up. The skull is large and shows a varying amount of inflation of the nasal chamber, with consequent modification of the surrounding bones. This inflation is greatest in such western species as *H. cristata* of the Mediterranean region, in which the nasal region is relatively enormous, the nasals very wide and convex upward, the frontal shorter than the nasals, and the upper profile of the skull very convex upward. The antorbital foramen is almost as large as the combined orbital and temporal fossae, and the zygomatic plate forming its ventral boundary is very slender, but the vertical arm forming the outer wall of the opening is broader. The cheek teeth are four above and four below on each side, with the formula: $i. \frac{1}{1} c. \frac{0}{0} pm. \frac{1}{1} m. \frac{3}{3} = 20$. The cheek teeth develop short roots which, however, do not remain open in adults. The enamel pattern as seen in partly worn teeth is rather complex, the high crowns having in the upper series a strong infolding running forward diagonally on the inner side, and two similar infolds on the outer side of the tooth. These outer reentrants cut off three enamel lobes which are further complicated by secondary down-folds of less vertical extent, so that when the teeth are well worn down to the level of the outer and inner reentrants, there are cut off five enamel lakes, more or less transverse, an anterior, then two nearly side by side, behind them a fourth and longer one extending nearly across the crown of the tooth, and last a smaller fifth on the outer half of the crown. The pattern in the lower molars is essentially similar but reversed, with the two main reentrants on the inner side of each tooth, and a single one on the outer side. The wide interpterygoid fossa extends forward to the level of the second molar, or slightly less, as an evenly converging arch. The type species is the European *Hystrix cristata* Linnæus.

The eastern members of this genus differ externally from the crested porcupines of Europe and Africa in the less development of the long erectile quills of the nape and in the less expansion of the nasals with consequently lower upper profile and other modifications of the surrounding bones of a less exaggerated sort. It has been usual to regard these less modified members as

representing a distinct genus, *Acanthion*, but probably Lönnberg (1923) and Osgood (1932) are right in making this a subgenus only, at least until the group can be studied as a whole with adequate material. In immature animals of the *Acanthion* group the very much larger size of the interparietal as compared with that of some of the western species is very striking. The ascending process of the premaxillary tapers rapidly and becomes as narrow terminally as the forwardly projecting corner of the frontal against which it abuts.

Externally the species are all much alike, but the proportions of the nasals and the surrounding bones seem to offer reliable characters for the discrimination of a number of different forms, although it must be admitted that the relationship of the Indian and Malayan porcupines to those of eastern China is still far from being satisfactorily determined. Thus the eastern Chinese porcupine with its Hainan race has nasals much longer than the premaxillaries, while in the specimens described as *H. yunnanensis* they are much shorter, and the animal is regarded by Bonhote, Thomas, and others as a distinct species. Until a further study of these animals can be made, this course may be followed. Osgood considers *H. subcristata* a subspecies of the Malayan *H. brachyura*.

KEY TO CHINESE SPECIES OF *Hystrix*

- A. Nasals long, extending considerably posterior to the level of the lachrymal bone.
 - a. Larger (mainland). *H. subcristata subcristata*
 - b. Smaller (island of Hainan). *H. subcristata papæ*
- B. Nasals shorter, not extending posterior to the level of the lachrymal bone. *H. yunnanensis*

466. *Hystrix (Acanthion) subcristata subcristata* Swinhoe

Hystrix subcristata Swinhoe, Proc. Zool. Soc. London, 1870, p. 638.

Acanthion subcristatus subcristatus G. M. Allen, Amer. Mus. Novitates, no. 290, p. 2, 1927.

Acanthion subcristatus A. B. Howell, Proc. U. S. Nat. Mus., vol. 75, art. 1, p. 68, 1929.

Hystrix (Acanthion) brachyurus subcristatus Osgood, Publ. Field Mus. Nat. Hist., zool. ser., vol. 18, p. 325, 1932.

Type specimen.—A skin and skull, now in the British Museum, from Foochow, Fukien, China. Collected by Robert Swinhoe about 1869.

Description.—Entire head covered with stiff brownish or blackish-brown hairs, except the ears which are nearly bare, with a few small whitish hairs on the upper margin. Sides of neck, shoulders, limbs, and belly blackish to blackish brown, the sides and shoulders with the hairs chiefly consisting of flattened spines grooved on the upper side. A small tuft of long white slender quills arises from the middle of the nape, most of them with dark-brown basal half. Over the posterior half of the back the quills become stout black spines

with white tips, interspersed with a few long slender quills, the former reaching a length of up to 225 mm., the latter 375 mm. or more. At the base of this armature there are many small whitish hairs with dark-brown bases, slightly curling, and attaining a length of about 65 mm. The short tail is quite concealed by the dorsal spines, and carries about two dozen specialized rattling quills, each with a short slender stem and an open-ended expanded capsule.

In addition to various characters of the skull already mentioned, the nasals are large and expand slightly posteriorly, so that the greatest transverse breadth at the lachrymal level is one and a half times that at the anterior end. The combined outline of the nasals posteriorly is broadly convex backward and the extreme posterior extension in the midline is about on a level with the middle of the orbitotemporal fossa. The great posterior width of the nasals encroaches upon the width of the frontals at their anterior corners, so that they are reduced here to a narrow process on each side, of about the same width as the narrowing premaxillary process which abuts against each. The upper tooth rows are practically parallel. The first cheek tooth (pm⁴) is the largest, with its long diameter slightly greater than the transverse, but the crowns of the three molars are more nearly circular in outline.

Measurements.—No dimensions of fresh-killed individuals are available. The flat skin of an adult is, however, about 710 mm. in total length, of which the tail comprises about 60 mm. The hind foot is about 75 mm. and the ear from meatus about 27.

Cranial dimensions are given in the following table.

CRANIAL MEASUREMENTS OF CHINESE *HYSTRIX*

No.	Greatest length	Basal length	Palatal length	Zygomat- ic width	Mas- toid width	Width across pre- molars	Upper cheek teeth	Lower cheek teeth	Median length of nasals	Locality
<i>H. subcristata subcristata</i>										
60174	138.0	129.0	79.0	74.5	52.0	29.5	29.0	29.0	80.0	Fukien
84357	139.0	128.0	75.0	72.5	50.5	28.0	30.3	32.0	81.0	Szechwan
84466	133.0	118.0	69.0	69.0	48.6	29.0	27.0	29.0	77.0	Fukien
84467	139.0	122.0	71.5	64.0	48.0	30.0	27.5	29.2	77.0	Fukien
84468	142.0	126.0	73.0	73.5	47.5	30.0	30.0	32.5	73.5	Fukien
84470	131.0	112.0	65.0	65.5	45.0	29.0	27.0	31.0	69.5	Fukien
<i>H. subcristata papæ</i>										
60048	135.0	121.5	72.0	65.0	46.0	28.0	30.0	29.0	74.5	Hainan
60042	131.5	127.6	65.5	65.5	46.3	25.4	29.6	30.0	66.0	Hainan
<i>H. yunnanensis</i>										
(type, from ANDERSON, 1879)	—	109.0	—	64.0	—	—	27.8	—	47.0	Yunnan

Occurrence and Habits:—The large porcupine is common locally throughout southern China, and no doubt was in former times more evenly distributed, but has disappeared from many of the more cleared areas. From the southern border it ranges northward on the coast through Fukien into Kiangsi and as far as Anhwei and southern Shensi in the mountains. Westward, the northern limit of range dips south to eastern Szechwan, and follows the southern border of that province, probably to western Yunnan. Mell (1922) found it to be un-

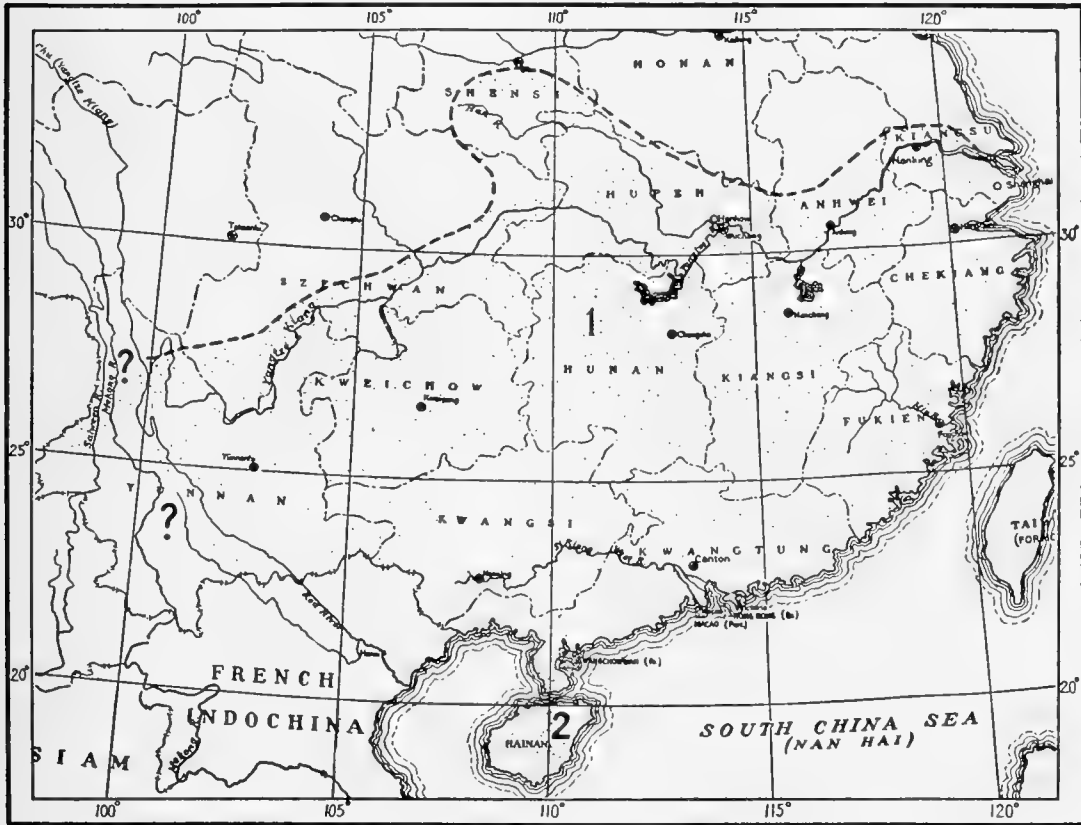


FIG. 61. Distribution Map.

Hystrix

1. *H. (Acanthion) subcristata subcristata*

2. *H. (Acanthion) subcristata papæ*

common in the south and north of Kwangtung, and mentions specimens taken at Wutsung, Lofau Shan, and Fungwahn. When dug out of their burrows, he says, they snort, stamp the hind feet, and rattle the tail with a sound like a motor starting, but if kept alive, they become in a few weeks less excited and rattle only when disturbed. At Fungwahn one was killed in its nightly foray on a bean garden at about one o'clock and beans were found afterward in its stomach. In the stomach of another there were leaves. Shih records it from

Kwangsi at Loshiang and Kutchen. In Fukien, whence Swinhoe's original specimen came, it is still to be found in some numbers. Mr. Clifford H. Pope, who secured several specimens for the American Museum, writes that porcupines are common in the vicinity of Futsing, Fukien. "They live in large burrows which have more than one entrance and are often made in clay banks on hill- or mountain-side. Sometimes the burrows are found among boulders on rugged slopes. Long, wide, criss-cross runways lead to them from many directions and may be followed for hundreds of yards through dense growth. Porcupines are very destructive to certain crops which they damage in their nocturnal raids." The Chinese name is "haochu." Swinhoe wrote in 1870 that he often heard of porcupines at Swatow, Kwangtung Province, as well as at Foochow, Fukien. Farther north, Sowerby (1929a) records that in 1929 the Shanghai hounds ran down and killed a porcupine in Soochow district, Kiangsu, a very unusual occurrence. He adds that it occurs in the mountains between Chinkiang and Nanking in the Yangtze valley, for he once shot one there in a pig drive. He also once found spines of the porcupine on the south side of the Tsingling Range in southern Shensi, which is probably nearly its northern limit. Père David as long ago as 1873 (1873, p. 555) found evidence of its presence during his stay of three and a half months near Sian, Shensi, for he mentions it in his letter to Swinhoe as being perhaps of the same species as the one from Fukien. Except for one secured by the Central Asiatic Expeditions at Wanh sien, eastern Szechwan, March 17, 1926, there is apparently but one other record for that province, namely, one from Suifu farther up the river, as recorded by A. B. Howell, who states that the skull, though broken, appears to have the long nasals of *H. s. subcristata* rather than the short ones of *H. yunnanensis*. An interesting record is of a skin from Likiang brought back by the American Museum Asiatic Expeditions, but since it is unfortunately without a skull, its final reference is questionable. It seems much rarer in southwestern China than in the eastern part, and apparently avoids the high country of this area. Of the Likiang specimens, Dr. Roy C. Andrews (1918) writes that when hunting big game with dogs he was often greatly annoyed to find that the latter had followed the trail of a porcupine to its burrow. "A porcupine will keep an entire pack of dogs at bay and is almost sure to drive its murderous weapons into the bodies of some of them unless the hunters arrive in a short time." Its method of defense is to spread its stout spines and suddenly charge backward against the enemy, driving the long quills in. A writer in the Journal of the Bombay Natural History Society even records an instance of a goat having been killed in this way. A full-grown porcupine, according to Sowerby, will weigh upwards of forty pounds, and its flesh is a great delicacy to the Chinese. Dr. Andrews writes that the Mosos eat its flesh which is white and fine. The porcupine will breed in captivity, bringing

forth usually two at a birth, and rarely three (Sowerby, 1929a). It is sometimes killed by the larger felines.

Specimens examined:—The following eleven:

Fukien: Futsing, 8; no exact locality, 1.

Szechwan: Wanh sien, 1.

Yunnan: Likiang, 1.

467. *Hystrix (Acanthion) subcristata papæ* (G. M. Allen)

Acanthion subcristatus papæ G. M. Allen, Amer. Mus. Novitates, no. 290, p. 3, 1927.

Hystrix hodgsoni Swinhoe, Proc. Zool. Soc. London, 1870, p. 233 (not of Gray).

Hystrix subcristata Swinhoe, *ibid.*, p. 638 (in part).

Type specimen:—An adult male, skin and skull, No. 60048, American Museum of Natural History, from Nodoa, island of Hainan, China. Collected January 9, 1923, by Clifford H. Pope.

Description:—Similar to the mainland form, called *H. s. subcristata*, but slightly smaller, with a lower and more slender skull; the nuchal crest is slightly less developed, and the large spines on the back are more extensively dark, with correspondingly shorter white tips.

The general color, as in the typical race, is dark blackish brown, with a white half-collar on the throat formed by short white spines; the short nuchal crest consists of elongated slender bristles, most of which are dark brown at the base and white for the distal two-thirds. In a series of nine adults this crest is much shorter and of darker bristles than in the Fukien series, and in a few cases is wanting. The elongate slender quills of the lower back are in both races white except at the extreme base, but the heavier spines have the dark middle portion more extensive, so that the white tips are much shorter, 35 mm. against 50 for the medium-length spines. All-white heavy spines are practically lacking.

The cranium is slightly more slender throughout, with conspicuously less vertical depth in the insular animal. The dorsal profile is very evenly convex and there is no indication of a postorbital process. The nasals are long, pointed anteriorly, at first relatively narrow and then expanding evenly in their posterior third. As in the mainland animal, their posterior extent reaches the level of the middle of the orbitotemporal fossa. The ascending branch of the premaxillary is alike in both, narrowing rapidly to a truncate posterior border that articulates with a short process of similar width at the antero-external corner of the frontal. Fusion of the bones of the roof of the cranium takes place with advancing age. The interparietal and parietal fuse intimately, then unite with the posterior part of the frontal. Later, the median

suture of the frontals also disappears. The cheek teeth, except for their less transverse width, are not different from those of the mainland animal.

Measurements:—None of the series of specimens is accompanied by flesh measurements. The skin of the type, as tanned, measures approximately 670 mm. in total length, the tail about 100 mm.

Cranial measurements are given in the table under *H. s. subcristata*.

Occurrence and Habits:—The presence of a porcupine on Hainan was suspected long ago by Swinhoe (1870a), who mentions the finding of one of the characteristic large quills in the forest near Nychow. It remained for Mr. Clifford H. Pope, however, nearly half a century later, to secure actual specimens. With the help of native hunters he succeeded in obtaining eleven skins, mostly with skulls, including two small young taken December 9, 1922, all from the vicinity of Nodoa. These were brought in two or three at a time during a month, and indicate that the animal is not rare in proper situations. Mr. Pope writes: "One brought in alive was very restless in his basket and constantly made nervous, quick little jumps to the rear causing its spines to be twisted out by the sides of the basket. It also made a rattling noise with its tail. My Chinese hunter tells me that the porcupine may be found abroad from ten or eleven o'clock in the evening till one or two in the early morning. He showed me a peanut field well scratched and dug up by porcupines, and in several other places I saw the same signs. I also found groups of holes under rooty banks that appear to be the work of these animals."

Although not a very strongly differentiated form, the greater slenderness of the skull and the slightly darker color seem to be constant in the series studied.

Specimens examined:—Eleven, as follows:

Hainan: Nodoa, 6 skins with skulls, 5 skins only.

468. *Hystrix* (*Acanthion*) *yunnanensis* Anderson

Hystrix yunnanensis Anderson, Anat. and Zool. Researches Western Yunnan, p. 332, 1879. Thomas, Journ. Bombay Nat. Hist. Soc., vol. 28, p. 432, 1922.

Type specimen:—The type is probably still in the Indian Museum at Calcutta. It is not specified by number in the original description, but doubtless came from "the mountains to the east of the Kakhyen hills" in extreme western Yunnan.

Description:—According to Anderson, this is externally quite like Swinhoe's *H. subcristata* of eastern and southern China, but the skull is apparently different in having very short nasals. The color is "dark brown on the head, neck, shoulders and sides, passing into deep black on the extremities, a very

narrow white line passing backwards from behind the angle of the mouth to the shoulder; under surface brownish . . . The crest begins behind the occiput and terminates before the shoulders; the hairs . . . are all paler than the surrounding hairs, and the individual hairs are either broadly tipped with yellowish-white, or they have a broad subapical band of that colour . . . The quills are wholly yellow, with the exception of a dark brown, almost black band, of variable breadth and position . . . The stout strong quills rarely exceed 6 inches in length, whilst the slender quills are 1 foot long."

The "distinguishing features of the skull of this species . . . are the nasals stopping short posteriorly, considerably anterior to the orbit, and even before the anterior angle of the external portion of the lachrymal; the nearly equal breadth maintained by the nasals throughout their length; also the greater breadth of the naso-frontal portion of the premaxillary, the posterior margin of which is considerably anterior to the first molar." The frontals are correspondingly long, their greatest length nearly equaling that of the nasals. The length of the parietals in the median line is in consequence about one-half that of the frontals. The teeth do not appear to yield any characters of distinction, although the upper incisors "show a tendency to longitudinal grooving and to the formation of nearly three distinct furrows."

Measurements:—No body measurements are given, but in the table under *H. s. subcristata* I have entered a few cranial measurements from Anderson's account.

Occurrence and Habits:—The status of this porcupine still remains in doubt. To judge from Anderson's careful description and comparisons, its very short nasals separate it at once from the porcupine of eastern China. Thomas has also emphasized this distinction and regards it as a valid species. Exactly how it is related, if at all, to other porcupines described from eastern India by Hodgson, Sykes and others is not clear at present, and until a thorough study of the subject can be made, it is impossible to do more than repeat Anderson's description which was based on a specimen from the Burma-Yunnan border in the Kakhyen Hills. It may prove, after all, to be not so different from other eastern members of the genus as that author supposed, and, on the other hand, the short nasals and other cranial characters may show its relationships to the more typical western *Hystrix*. To complicate the matter further, fossil or subfossil porcupines have recently been described from China: *Hystrix (Acanthion) lagrelii* Lönnberg, from Honan, and *H. kiangsenensis* Wang. The former is apparently not very different from the living species.

Specimens examined:—None.

CHAPTER XIV

ORDER ARTIODACTYLA

EVEN-TOED UNGULATES

The hoofed mammals are undoubtedly derived from ancestors that were originally clawed and flesh-eating. With the adoption of a vegetable diet they became more toothsome and a prey to the primitive carnivores, to escape which they developed speed and hoofs, while the teeth at the same time became slowly transformed from a cutting to a grinding and crushing type. In the hoofed mammals with "cloven" feet, the axis of support passes between the third and fourth digits of the foot, which, with the disappearance of the innermost of the original five digits, results in a bilaterally symmetrical arrangement, with the two central toes large and the two outer ones, if present, much smaller. The teeth are modified for chewing vegetable food by: (1) the blunting of the original cusps of the molariform teeth, resulting in a knobbed or bunodont tooth; or (2) the original four cusps of the primitive molar may widen and become crescentic or selenodont, with grinding surface. In the Artiodactyla the upper molars consist of two pairs of knobs or of crescents, while the premolars are of a single transverse pair, so that the permanent premolars are always simpler (usually corresponding to one-half of a molar tooth). The incisors are used for plucking the food and tend to be reduced in the upper jaw or lost altogether. The canines are retained as weapons of extravagant growth in the form of tusks, or are lost. In the cattle and antelope a bony outgrowth of the skull furnishes a pair of horns for defense, or, as in the deer, antlers which are usually branching and periodically renewed. The stomach is modified for the digestion of vegetable food by the development of three or four separate compartments for storage and digestion of the masticated material which, except in the pig family, is regurgitated for a second chewing (rumination).

Three families of this order are represented in China, and possibly a fourth, if the occurrence of the Mouse-deer can be substantiated. These three may be told by the following key:

KEY TO FAMILIES OF CHINESE AND MONGOLIAN ARTIODACTYLA

- A. Incisors present in both upper and lower jaw; canines turned outward, those of the upper jaw bearing against those of the lower, keeping the latter sharp for defensive use; molar teeth bunodont; horns or antlers never developed; stomach simple. Family Suidæ (Pigs)
- B. Incisors in the lower jaw only; lower canines incisiform, small; upper canines either tusk-like or absent; molar teeth selenodont; horns or antlers present or not; stomach three- or four-chambered.
- a. Cheek teeth relatively short-crowned with roots; upper canine, if present, tusk-like; deciduous antlers in males of most species, but in those in which antlers are lacking the upper canine forms a long curved tusk. Family Cervidæ (Deer)
- b. Cheek teeth high-crowned, more or less rootless, with pulp cavity closing late in life; upper canine absent; permanent horns present as continuous bony outgrowths of the frontals but usually smaller or sometimes absent in females. Family Bovidæ (Antelopes, Sheep, Cattle)

It is quite possible that the Camelidæ should be included, since the Bactrian Camel is by some believed to be, at least originally, a native of the central Asiatic deserts, perhaps extending into the Gobi. Finsch (1876) many years ago reported that wild camel were said to occur some two hundred to two hundred and fifty versts southeast of Zaisan, and Pousargues (1898b, p. 136), after quoting Pallas and Przewalski as to the range, adds that they are found wild on the plateau between Bogdo Ola and Kourouk Tagh on the lower Tarim basin and about Lob Nor, and were especially abundant in the desert of Koum Tagh between Hami and the oasis of Sachow, western Nan Shan, and on the highlands of Bei-shan (?Peishan), not going farther east than the regions watered by Etsin Gol. They are unknown from the desert of Alashan. Additional "Field notes on the wild camel of Lob-Nor" are published by Littledale (1894). There seems to be no way of telling whether or not these wild herds are native to the region or were from stock that escaped from captivity, so I have omitted them from the account of native species.

Concerning the Mouse-deer, Swinhoe (1869, 1870c) writes that "Hainan produces a Mouse Deer, which I have made out to be the *Tragulidæ meminna*," but his account indicates that he knew it only from native reports of small hoofed animals which may have been young muntjacs. At all events, subsequent collecting has failed to reveal any such animal.

Family SUIDÆ

PIGS

The pigs are characterized by their long heads, long snouts with a rounded terminal pad for rooting, their relatively short legs and coarse bristly pelage. The upper incisors are three in number on each side; the canines curve outward and upward in both jaws. The lower incisors are proclivous, three on each side. The anterior premolars retain the primitive compressed form of the crown, but the molars and to some extent the last premolars become bunodont. The anterior two upper molars consist of two pairs of blunt cusps arranged in two transverse rows, but the last molar is more complex with a third cross-row of blunt cusps, of which the inner is the larger. Many small cusplets fill the intervening valleys. Young animals have a longitudinally striped pattern. The family is wholly an Old World one, represented in the northern continents by the genus *Sus* or typical pigs, but in Africa by several other genera as well. In China and the forested parts of Mongolia only the genus *Sus* is found.

Genus *Sus* Linnæus

WILD BOAR

Sus Linnæus, Syst. Nat., ed. 10, vol. 1, p. 49, 1758.

Sinissus Heude, Mém. concern. l'Hist. Nat. de l'Emp. Chin., vol. 2, pt. 2, p. 102, 1892 (for Chinese pigs).

The genus *Sus* includes the wild swine of Europe and Asia. In them the rostral part of the skull comprises about half of the skull's length, with much elongate nasals. There is a pronounced postorbital process and a corresponding projection on the jugal bone, but the orbit is not completely encircled by bone, and the orbital and temporal fossæ are not separated. The occiput is produced upward, high, narrow and overhanging. The tooth formula is the primitive one for placental mammals: $i.\frac{3}{3} \ c.\frac{1}{1} \ pm.\frac{4}{4} \ m.\frac{3}{3} = 44$. The first two upper incisors are broad and laterally compressed, the third smaller, terete. The lower incisors are proclivous, compressed and stout. The upper canine curves down, out and upward with a band of ribbed enamel on its ventral aspect. The lower canine is triangular in section, enamel-covered except on the posterior face which is cut away by wear against the upper canine, thus maintaining a sharp inner and outer edge. The anterior premolars 1 and 2 have compressed crowns, showing in profile three blunt cusps. The succeeding teeth become bunodont and of increasing size and complexity. The upper and lower molars have their blunt cusps arranged in two opposite pairs, and the third molars are additionally complicated by a third cross-row of cusps, a larger and inner one and two or three smaller outer ones. The audital bullæ are longest in their vertical axis and pouch-shaped, while just behind each is a very long styloid process. Externally the wild pig has a bristly coat, with in

northern races a sparse growth of under hair. The size is variable, the boars larger than sows, and though of large and clumsy appearance on their short legs, they can maintain a good rate of speed for short distances.

The number of recognizable geographic races of wild pig in China and Mongolia can be determined only by the further study of large series. The great amount of individual variation makes it difficult to tell what are general characters of the species and what are the result of geographical causes or isolation. The nomenclature is further complicated by the labors of Père Heude, who described and named a large number of "new species" from China, basing his distinctions on slight variations in the tooth structure. His concept of "species," however, is different from that usually held and implies merely observable differences that are, in fact, of an individual nature, so that in some cases several "species" may be found in a single herd. According to the usual method of treatment, there seem to be not more than three subspecies represented among the large number of specimens seen, and these differ but slightly in their average characters. The type species of the genus is *Sus scrofa* Linnæus, the wild boar of southern Europe.

469. *Sus scrofa raddeana* Adlerberg

Sus scrofa raddeanus Adlerberg, Compt. Rend. Acad. Sci. URSS, 1930A, p. 95, figs. 2, 3.

Sus scrofa ferus Radde, Reisen im Süden von Ost-Sibirien, vol. I, p. 233, 1862 (part).

?*Sus canescens* Heude, Mém. concern. l'Hist. Nat. de l'Emp. Chin., vol. 2, pt. I, p. 54, 1888 (*nomen nudum*);

ibid., vol. 3, pt. 4, p. 192, pl. 31, figs. 3-5, 1897.

Sus scrofa ussuricus G. M. Allen, Amer. Mus. Novitates, no. 430, p. 2, 1930 (?not *Sus ussuricus* Heude, 1888).

Type specimen.—A skull of an adult male, No. 14755 Osteol., Zoological Museum of the Academy of Sciences, Leningrad, U.S.S.R., from Sugu Nor, southern Kentai Mountains, Mongolia. Collected in May, 1924, by P. K. Kozlov.

Description.—Color rather light, a toptype being olive brownish (between deep olive buff and dark olive buff) on the back, darkening on the flanks and shoulders to near wood brown; ears the same; parts of the head darker, with admixture of black hairs; throat and groin covered with silvery-gray hair; legs dark brown; tail like the back tipped with dark brown. Under fur rather light in color, near vinaceous buff (Adlerberg). Some young specimens are darker. An immature female from near Urga has the neck and body pale gray brown, the long, coarse hairs with extensive whitish bases and pale-brown or drab tips. On the shoulders the hair in the midline is longer, forming a drab crest with very little intermixture of white; forehead and cheeks mixed dark brown and whitish; backs of the ears and a small patch behind the snout dark brown; the ears with white hairs along their anterior rim. The chin is dark brown and this color extends back as a narrow line to the axilla, separating a white mus-

tachial line behind the angle of the mouth from the white area of the throat, where the direction of the hairs is reversed. Both fore and hind feet are dark brown to the hoofs, blending above with the general color of the body. The tail ends in a tuft of long blackish-brown hairs. At the base of the longer hairs of the body there is an abundance of fine woolly hair, pale brown in color.

The type skull is described as relatively small, short and high, with the profile straight or slightly convex in the frontal region; lachrymal bone short and high, squarish in outline, with a narrow process running forward along the upper margin of the maxillary. Third upper molar short and relatively broad, its talon weakly developed and simpler than in European *S. scrofa*.

Measurements:—No external measurements are available, but the animal is apparently of medium size.

Dimensions of a skull from Urga are given under *S. s. moupinensis*. The type skull is said to have a total length of 373.8 mm.; condylobasal length, 336.2; zygomatic width, 143.3; third upper molar, 35.5 by 22.5.

Nomenclature:—In seeking for a name to include the wild pigs of northern Mongolia, I previously had used Heude's *Sus ussuricus*, assuming that it might not be very different from the animal of the Ussuri region. This is the first of five names given by that author to wild pigs of the same general region, the other four being *S. canescens* (type locality, Peiping), *S. gigas* (type locality, Vladivostok), *S. songaricus* (type locality, valley of the Sungari River, northern Manchuria), and *S. mandchuricus* (type locality, Mukden, Manchuria). It seems unlikely that the animal of Peiping would be very different from that of northern Mongolia, since this is not the case with various small mammals, hence the name *S. canescens* would be a likely and appropriate one if it proves that the pigs from northern and eastern Manchuria are really different. In this case, *S. s. raddeana* would become a synonym of *S. canescens*, but since *S. ussuricus*, *S. songaricus*, and *S. mandchuricus* have page precedence of *S. canescens*, it must first be shown that they are unavailable. In describing the Mongolian animal as new, Adlerberg has taken none of these names into consideration. He has, however, compared his animal with winter skins of *Sus s. nigripes* Blanford, type locality Tien Shan, Sinkiang, and believes it to be distinct, though "probably distributed north-eastwards in some part of north-western Mongolia." It must be admitted, however, that there is no conclusive evidence adduced on this point. In any case, *S. ussuricus* should probably replace *S. gigas* for the northeastern pig, for the latter name was not published until 1892 in the second part of the monograph by Père Heude, while *S. ussuricus* first occurs in the preceding part, 1888, and, although here mentioned only in a preliminary way, is identifiable by a statement of the locality and reference to the accompanying plate of the dentition. In this connection,

the *Sus leucomystax continentalis* of Nehring, 1889, also from Vladivostok, would then be a synonym of *S. ussuricus*. The important points to be demonstrated in setting up *S. s. raddeana* are therefore: (1) to show that it is sufficiently distinct from *S. scrofa* of Europe; (2) to prove its real distinctness from the central Asiatic *S. s. nigripes* of Blanford, 1875; (3) to show that it is distinct from the pigs of the Ussuri, of northern, eastern, and western Manchuria, to all of which, names have been given by Père Heude; and finally that (4) these are in turn distinct from the wild pig of the Peiping region. At present these points cannot be determined, while, judging from analogy with other species, it is likely that the Mongolian pig is the same as that of Peiping and perhaps identical with that of Mukden (Heude's *S. mandchuricus*). Rather than further complicate the matter, however, I have used Adlerberg's name temporarily, awaiting a fuller discussion of the case based on more material.

Occurrence and Habits.—Wild pigs are apparently not very common along the forested edge of the northern Gobi in Mongolia. The only specimen secured by the American Museum Asiatic Expeditions was a subadult female from sixty miles northeast of Urga. The specimen made the type of *S. s. raddeanus* and a skin of a second specimen were from the Kentai Mountains slightly farther east. It is a paler mixed brown and white animal than most of those I have seen from parts of China to the south of the Mongolian deserts. Radde gives the best account of the habits of wild pigs in this region, although most of his experience relates to localities just north of the Mongolian border. He did not find any evidence of its presence in some of the wooded parts of this area, indicating a local distribution, nor does it occur in the high tablelands of Dauria. In the eastern Syansk Mountains it appeared to be altogether wanting at the time of which he writes (the early sixties) from the valley of the Oka eastward to the region of Karnot. It was found sparingly in the lower course of the Kitoi, a parallel stream. None were found in the Alexandrovsk region nor in the mountains of the Baikal region, but in the country at the southwest end of Lake Baikal it was not uncommon, in summer ascending the mountains to an altitude of about 5,000 feet. Here it was feeding chiefly on the roots of *Sanguisorba*. Wild pigs are partial to oak forests, as Radde noted in the Bureja Mountains, partly because of the abundance there of lilies and peonies, on the tubers of which they feed, as well as the cones and nuts of the large *Cembra*, here of unusual size. In the Syansk and Apple Mountains the pigs seemed small and undernourished. There appear to be no records of pigs in northwestern Mongolia.

Specimens examined.—One from sixty miles northeast of Urga; one from Laotsatzu, Hopei.

470. *Sus scrofa moupinensis* Milne-Edwards

- Sus moupinensis* Milne-Edwards, in David, Nouv. Arch. Mus. d'Hist. Nat. Paris, vol. 7, Bull., p. 93, footnote, 1871. Milne-Edwards, Recherches pour servir à l'Hist. Nat. des Mammifères, p. 377, pls. 80-81, 1868-74 (1874).
- Sus oxyodontus* Heude, Mém. concern. l'Hist. Nat. de l'Emp. Chin., vol. 2, pt. 1, p. 54, 1888 (*nomen nudum*); *ibid.*, vol. 2, pt. 2, p. 114, pl. 20B, fig. 11, 1892. Shensi, upper Han River.
- Sus dicurus* Heude, *ibid.*, vol. 2, pt. 1, p. 55, pl. 17, fig. 2, 1888. Shensi, divide between Han and Kincha Rivers.
- Sus paludosus* Heude, *ibid.*, vol. 2, pt. 2, p. 114, pl. 20, fig. 5; pl. 20A, fig. 4, 1892; *ibid.*, vol. 3, pt. 4, p. 193, 1897. Near Chinkiang, Kiangsu.
- Sus curticens* Heude, *ibid.*, vol. 2, pt. 2, p. 114, pl. 20A, fig. 7; pl. 29A, fig. 3, 1892.
- Sus laticeps* Heude, *ibid.*, vol. 2, pt. 2, p. 114, pl. 20A, fig. 8, 1892.
- Sus collinus* Heude, *ibid.*, vol. 2, pt. 2, p. 114, pl. 20, fig. 4; pl. 20B, fig. 15, 1892.
- Sus acrocranius* Heude, *ibid.*, vol. 2, pt. 2, p. 114, pl. 20, fig. 7, 1892.
- Sus vittatus* Buechner, Bull. Acad. Imp. Sci. St. Pétersbourg, vol. 34 (new ser., vol. 2), p. 117 (Mélanges Biol., vol. 13, p. 163), 1892.
- Sinismus collinus* Heude, Mém. concern. l'Hist. Nat. de l'Emp. Chin., vol. 4, pt. 3, p. 128, 1899. Ningkwo, Anhwei.
- Sinismus planiceps* Heude, *ibid.*, vol. 4, pt. 3, p. 132, 1899. Ho Shan, Anhwei.
- Sinismus moupinensis* Heude, *ibid.*, vol. 4, pt. 3, p. 132, 1899.
- Sus scrofa moupinensis* G. M. Allen, Amer. Mus. Novitates, no. 430, p. 3, 1930.

Type specimen.—The type was a skin and skull from Muping, Szechwan, China, collected by Père Armand David about 1873, and sent by him to the Muséum d'Histoire Naturelle at Paris where it presumably still is.

Description.—The pigs of the Yangtze northward are on the average paler in color than those of South China, but it is hardly possible to draw a precise dividing line. At least two distinct types of coloration occur: one in which the body is chiefly blackish with a sprinkling of white hairs; the other in which the body is chiefly ochraceous, more or less mixed with black. An old boar may be nearly black (Sowerby, 1930a). This is a decidedly darker animal than that of northern Mongolia and in winter has a considerable coat of under-wool, mostly absent in pigs of South China.

In the young the pelage has a striped pattern consisting of a median black stripe, and then, laterally beginning at the nape, a stripe of ochraceous, then a wider blackish-brown stripe with a line of rusty hairs in its posterior half, next another ochraceous stripe more or less broken posteriorly, next a buffy flank stripe also broken up into spots on the haunches, and finally a short blackish side stripe. The median black stripe may have its central part over the rump mixed with rusty hairs. The head and ears are brown with a mixture of buffy, and there is a pale buffy ring surrounding the front half of the eye. The feet are pale whitish or buffy, instead of black as in the adult.

The skulls of the European wild pigs were believed by Milne-Edwards to be more flattened in the profile view instead of decidedly convex, while the occiput between the temporal fossæ is narrower. The Chinese pigs do, on the average, have a slightly more convex profile and wider occiput, but they vary individually, so that it becomes difficult to find very satisfactory characters.

PLATE XI



Head of a Wild Pig (*Sus scrofa moupinensis*), adult female, killed at Heshuin, Shansi



Wild Pig country near Heshuin, Shansi

It is also a question whether the pig of Muping, to which Milne-Edwards gave the name *Sus moupinensis*, is more nearly like the northern pigs or those of southern China. A single female skull from Tatsienlu, and so not far from the type locality, is of the broad-fronted sort, and hence may be associated with the northern, while the southern pig is slightly narrower and is referred to the race *S. s. chirodonta*.

Measurements:—No measurements of fresh specimens are at hand, except those of Sowerby (1923c, p. 269) of a large boar shot near Kolan Shan, western Shansi, namely:

Tip of snout to tip of tail in straight line.....	74.0 inches
Height at shoulder.....	37.0 inches
Girth behind shoulder.....	52.0 inches
Girth at center of body.....	53.5 inches
Length of ear.....	4.5 inches
Weight, entire.....	320.0 pounds

Sowerby adds that large boars may weigh up to nearly 400 pounds, but pigs of such size are seldom seen in the Shanghai markets. He records (1918, p. 42) another from Shansi that weighed 330 and another of 310 pounds, while a fourth from southern Shansi was approximately 390 pounds.

CRANIAL MEASUREMENTS OF *SUS*

No.	Great- est length (condyl- obasal)	Occi- put to tip of nasals	Pala- tal length	Length of nasals	Zygo- matic width	Width across post- orbi- tal pro- cesses	Occip- ital width	Width out- side last upper molars	Upper cheek teeth (pm's and m's)	Lower cheek teeth (pm's and m's)	Sex	Locality
<i>S. scrofa raddeana</i>												
(type)	333	—	—	—	143.3	—	—	—	—	—	♂	Mongolia
<i>S. scrofa moupinensis</i>												
7952 MCZ	—	365	220	172	143	109	64	72.0	122	140	♀	Szechwan
45498	331	373	230	198	156	109	64	78.0	121	140	♂	Shansi
(type)	—	392	—	—	—	112	—	—	115	—	—	Szechwan
<i>S. scrofa chirodonta</i>												
41472	295	328	199	160	132	93	65	66.0	118	126	♀	Fukien
41473	300	334	208	173	134	99	68	69.5	113	123	♀	Fukien
47859	308	338	213	170	140	95	66	70.0	120	129	♀	Fukien
57325	332	365	217	172	146	99	69	72.0	121	131	♀	Fukien
84449	322	351	213	168	146	107	77	76.5	127	139	♀	Fukien
57326	324	355	225	183	140	100	71	74.0	128	139	♀	Fukien
47862	330	365	230	199	155	107	79	78.0	118	131	♂	Fukien
57323	354	396	248	207	164	117	83	76.0	117	137	♂	Fukien
84450	335	363	232	180	162	107	81	73.0	125	136	♂	Fukien

Nomenclature:—The Wild Pig of Muping was the first of the Chinese pigs to be named, in 1871. Its characters, however, are not very striking and it is exceedingly difficult to draw any dividing line between those of North China and South China. In a general way the former have a slightly greater average width across the orbital processes and average paler, with a fairly abundant under wool in winter, but whereas the line of division may be placed in the latitude of the Yangtze basin, it is of course not possible to make a sharp separation. Specimens from northern China seem more like the western Szechwan pigs in the width across the face, so the name *moupinensis* is here taken to include them. Of the many names bestowed by Heude in his study of Chinese pigs, *Sinismus* as a group name for them can be nothing but a synonym of *Sus*, while of the others one has to sort out those based on northern pigs and include them as synonyms of *moupinensis* if the latter name is regarded as applying to those of North China and the highlands of Szechwan. Thus the many other names he gave to Chinese pigs are left for the southern race, south of the Yangtze. Naturally, some of these appellations are based on intermediate specimens from the Yangtze basin, so that their allocation is more or less arbitrary. Sowerby (1917) has reviewed Heude's work on the basis of some of the original material in the Sikawei Museum, Shanghai. The series of pig skulls comprises thirty specimens from thirteen localities, described as eighteen "species." These Sowerby reduces to five possibly valid forms, including: (1) *Sus paludosus* of the Yangtze valley; with this, Heude's *collinus*, *chirodontus*, *stricticeps*, *acrocranius*, *flavescens*, and *nigricans* are regarded as synonymous; (2) *S. moupinensis*, to which are referred also, Heude's *oxydontus*, *laticeps*, *curtidens*; (3) *S. gigas* of Manchuria and the Ussuri, type from Vladivostok, regarded as a valid race, but the name is antedated by Nehring's *continentalis* (1889) and Heude's *ussuricus* (1888); (4) *S. melas* (misprinted *meles*), a name given by Heude to a skull, with short nasals and wide forehead, from Kiangsi.

Occurrence and Habits:—The Wild Pig or "yeh chu," according to E. H. Wilson (1913), is "very common" through western Szechwan and western Hupeh, doing much damage to the potato and maize crops of the natives. Pigs are nocturnal to a large degree, hiding by day in brush and under ledges of rock. Wilson mentions that they will even build large mounds of long dry grass and sleep under them, and tells of examining such a heap, and being much startled by the pig that awoke and dashed away from under its cover. In these western mountains he found signs of pig abundant and acres of ground that had been rooted over by them. Wa Shan is an especially good place for them, and it was here that Zappey in 1908 witnessed the killing of one by three Wild Dogs. Evidence was not wanting that pigs range up to altitudes of about

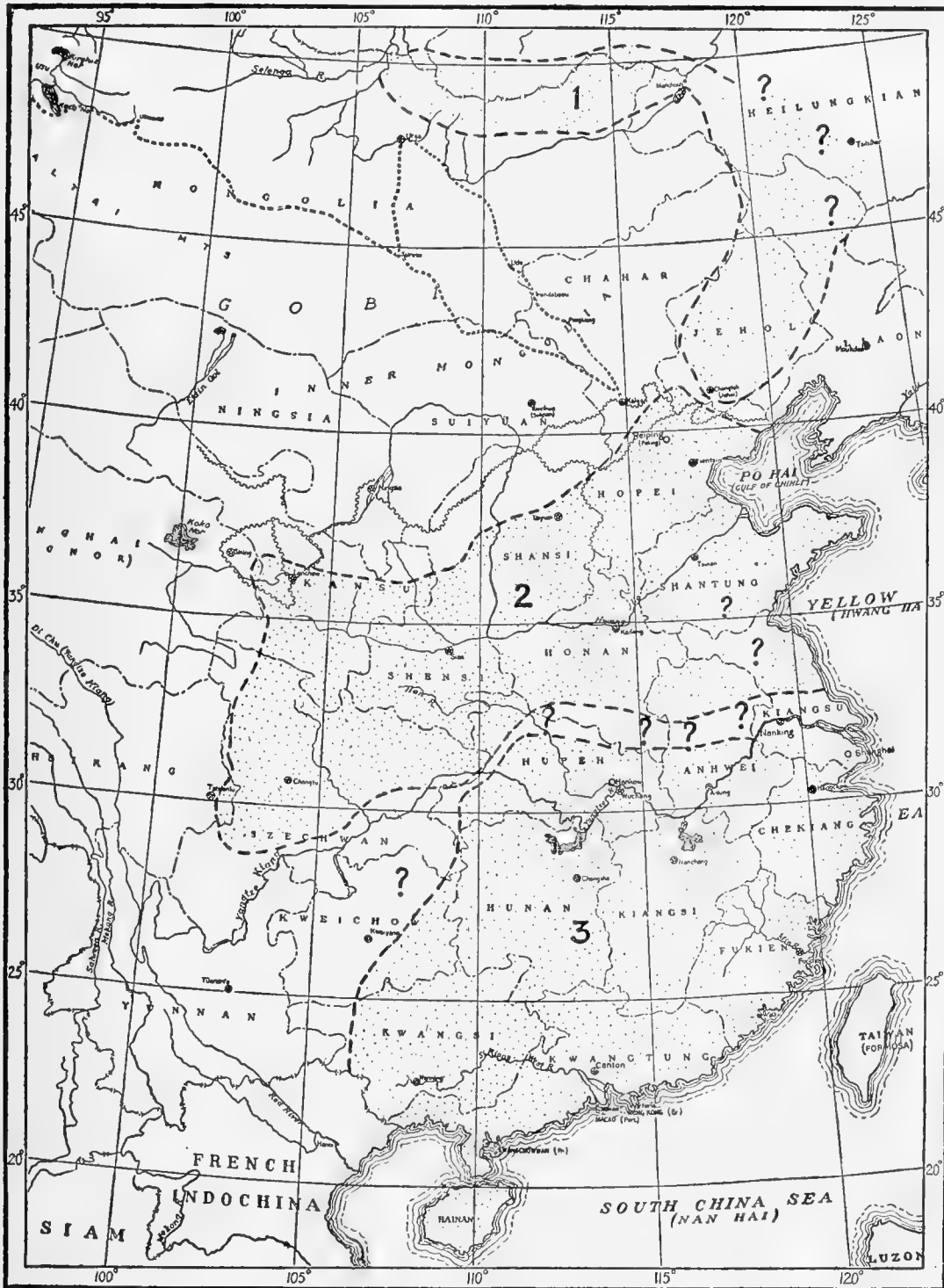


FIG. 62. Distribution Map.

*Sus*1. *S. scrofa raddeana*2. *S. scrofa moupinensis*3. *S. scrofa chirodonta*

9,000 feet and even more, and were found in numbers from Lungan in the north to Wa Shan in the south and as far west as Tatsienlu. The Chinese hold the flesh in high esteem and hunt it assiduously. In southern Kansu Berezovski found pigs common in the mountains, but only seldom coming down into the valleys (Buechner, 1892). Northern Shensi is probably much too dry for them, but they are found in the river valleys of the southern part of the province and are numerous in central and southern Shansi. Sowerby, who has hunted them in the latter province, found them common west of the Fen River in mountainous scrubby country, and calls attention to the marked seasonal differences in the coat.

Williston (1926) writes that near Lungan, northern Szechwan, pigs are such a pest that farming cannot be done, while according to E. H. Wilson watchmen with gongs are regularly stationed to guard grainfields during the growing season and produce a hideous din the entire night through. In commenting on a boar killed twelve miles south of Yen-anfu, Shensi, Sowerby says that they are a scourge to the natives, destroying acres of crops. In the mountainous or hilly districts they are common wherever there is good cover, and range westward into Tibet.

Sowerby (1914) has given an excellent brief sketch of his hunting experiences after wild boar in Shansi. They prefer well-forested areas, particularly scrub-oak growth, and sunny slopes well protected with pines and spruce where in winter they may lie up during the day. In summer they resort to streams and pools in ravine bottoms, feeding at night rather late. Country suitable for wild pig is found not only in the north and west of Shansi and in many parts of Shensi, but also in northern Hopei. Sowerby says that the wild pig is very prolific, old sows producing as many as fifteen young in a litter. "The mother builds a nest of hazel stems, carefully laid over a deep hollow. Here she produces her brood, the young remaining in this shelter for some days after they are born. After leaving the nest they stay with the old sow for about six months, by which time they are half grown and thoroughly capable of caring for themselves. . . . In winter the coat is long and very bristly, with a thick woolly under fur." The habit of building a nest for the reception of the young is an interesting and peculiar habit for an ungulate, and is shared by the Red River Hog of Africa. According to Sowerby's notes, the wild pig has increased, at least in the years just preceding 1914, in Shansi. In the winter of 1913-14, however, their numbers were reduced by an epidemic that spread throughout that country, killing off "whole sounders" at a time. A similar epidemic had occurred a number of years previously, "absolutely depleting certain sections of country of their stocks of wild swine." It would be valuable to know if there is any regular periodicity to these epidemics.

As a sporting animal the wild boar is a favorite among many hunters. Its

alertness, courage and resolution are well known, and of its endurance and ability to keep ahead of its pursuer even when seriously wounded, Sowerby has given some interesting experiences. In Chinese cover the irregularity of the ground does not admit of the "pig-sticking" so popular in parts of India, but the hunter must go afoot with rifle, and match his skill against the alert senses of the animals which apparently seldom make any stand unless cornered or wounded but seek safety in retreat to thick cover. The record length of a wild boar's tusk when removed is said to be ten inches for North China (Sowerby, 1914), while those from the Yangtze and South China are smaller.

Specimens examined:—The following nine:

Szechwan: Tatsienlu, 1 skull (M.C.Z.); Wanhsien, 3, including two small young.

Shansi: Heshuin, 4.

Hopei: Laotsatzu, 1.

471. *Sus scrofa chirodonta* Heude

Sus chirodontus Heude, Mém. concern. l'Hist. Nat. de l'Emp. Chin., vol. 2, pt. 1, p. 54, 1888; *ibid.*, vol. 2, pt. 2, p. 114, pl. 20, fig. 3; pl. 20A, fig. 3, 1892. Poyang Lake, Kiangsi.

?*Porcula taiwanus* Swinhoe, Proc. Zool. Soc. London, 1862, p. 360. Formosa.

Sus leucomystax Swinhoe, *ibid.*, 1870, p. 639 (?not of Temminck).

Sus leucorhinus Heude, Mém. concern. l'Hist. Nat. de l'Emp. Chin., vol. 2, pt. 1, p. 54, 1888 (*nomen nudum*); *ibid.*, vol. 2, pt. 2, pp. 114, 115, pl. 20, fig. 6; pl. 20A, fig. 6; pl. 29B, fig. 4, 1892.

Sus palustris Heude, *ibid.*, vol. 2, pt. 1, p. 54, footnote, 1888 (not *Sus palustris* Rütimeyer, 1861).

Sus paludosus Heude, *ibid.*, vol. 2, pt. 2, pp. 110, 114, pl. 20, fig. 5; pl. 20A, fig. 4, 1892 (substitute for *S. palustris* Heude, not Rütimeyer); *ibid.*, vol. 3, pt. 4, p. 193, pl. 30, figs. 1, 2, 5, 7-9, 1897.

Sus melas Heude, *ibid.*, vol. 2, pt. 2, p. 114, pl. 20B, fig. 12, 1892. Kwangsi.

Sinicus flavescens Heude, *ibid.*, vol. 4, pt. 3, pp. 130, 133, pl. 26, figs. 7-12, 1899. Yangtze and Taihu, Kiangsu.

Sinicus chirodonticus Heude, *ibid.*, vol. 4, pt. 3, pp. 130, 133, pl. 26, figs. 1-6, 1899. Poyang Lake.

Sus meles Sowerby, Proc. Zool. Soc. London, 1917, p. 15 (misprint for *melas*).

Sus scrofa chirodontus G. M. Allen, Amer. Mus. Novitates, no. 430, p. 4, 1930.

Type specimen:—The type is apparently one of the skulls in the Heude Collection at the Sikawei Museum, Shanghai, China. No number given. The locality is Poyang Lake, Kiangsi, China.

Description:—The wild pig of South China differs but slightly from that of North China, the chief points being that the average skin is darker, the pelage in summer lacks the fine wool at the base of the coarser hairs and in winter it is but scantily developed, and in the skull the width across the forehead is slightly less in proportion to the length. Sowerby states that the tusks do not reach so great a development. A series from Fukien shows considerable variation: some are practically all black with a suggestion of a pale line at the corner of the mouth, but most of them are of the "red" type in which the long hair is mixed black and deep rusty to maroon, only one of the series approaching the mixed ochraceous and whitish common to the North China skins.

The skulls of southern pigs are barely distinguishable from those of the

north; those from Fukien, however, average slightly narrower across the forehead.

Measurements:—No external measurements are available.

For cranial measurements, see table under *S. s. moupinensis*.

Nomenclature:—The correct name for this race of Chinese wild pig is still subject to correction whenever a final revision can be made. Swinhoe used Temminck's *Sus leucomystax* for it, but this name is based on the Japanese pig, which is apparently not really very different. Swinhoe's *taivanus* is the domestic pig of Formosa, and perhaps inseparable. Disregarding these as inapplicable, however, the series of names proposed by Père Heude for pigs of South China again comes up for consideration. Sowerby (1917), in connection with his restudy of the type skulls in the Sikawei Museum, determined upon *Sus paludosus* as the oldest of these applicable to a wild pig of the Yangtze and south. This name was not published until 1892 (page 110 of the second part of the monograph) and is apparently a substitute name for *S. palustris* Heude, proposed in a footnote on page 54 of the 1888 contribution, but the latter name is many years antedated for a fossil European pig. In this 1888 contribution, Heude on page 54 first introduces the name *Sus chirodontus* with the statement that the elaborate description that follows is based chiefly on this animal, which comes from the basin of Poyang Lake, Kiangsi. Comparative notes are given concerning this pig and *S. erymanthius* Gaudry, so that the name as here first published is not a *nomen nudum*, as Sowerby evidently supposed when he employed *S. paludosus* Heude as the valid name of the South China race. Heude's *Sinismus*, proposed as a generic name for Chinese wild pigs, is also untenable. Sowerby in studying Heude's material at Shanghai, found two other manuscript names, *Sinismus stricticeps* and *S. nigricans*, written on skulls from South China by the same author, and in his paper misquotes *melas* as *meles*, based on a skull from Kwangsi, a mistake repeated by A. B. Howell (1929). Since all these names appear to refer to but one race, that of southeastern China, they are all synonyms of the one first published, which is *Sus chirodontus*, described in the 1888 paper in an informal way, and illustrated in the 1892 contribution. I am therefore using this latter name for the animal.

Occurrence and Habits:—As in other parts of China, pigs are locally common in the southeastern portions of the country. Caldwell (1924), who has devoted much time to observing and hunting them, has given an excellent account of his experiences in the country about Yenping, Fukien, from which the following notes are condensed. He found small herds not uncommon even about the larger coast towns in the hills, but farther back in the mountains they are really abundant, as shown by signs almost everywhere. In some sections, so great is the damage they do to growing crops, that farming has

been entirely abandoned over large areas which in former times produced quantities of rice, while numerous hamlets have been deserted on account of the raids of these animals, which utterly destroyed the crops. Such abandoned homesteads, grown over with grass and bushes, offer an attractive stronghold for other kinds of larger wild beasts. The largest boars, says this writer, are usually discovered solitary upon the highest mountain plateaus, except during the rutting season when they associate with the herds. At all times pigs seem to be wary, doing most of their active feeding by night, and if found abroad by day, taking alarm at once. When hunted by the method of driving, pigs often show great intelligence in avoiding the posted hunters, and by extraordinary stealth and quietness often slip through the line unobserved. Caldwell relates one instance when with a companion he was proceeding quickly along a mountain path, and stumbled upon the disemboweled body of a man, the blood still steaming. The unfortunate person had been charged by a wild boar that, becoming aroused or irritated in some way, had ripped him open by a single slash of the tusks. On another occasion some wood-gatherers disturbed a boar on an almost barren hill, whereupon the animal had charged the first person in sight, inflicting a severe wound in his thigh, then continuing down the hill the animal had attacked every person along its line of retreat until nineteen persons were laid out more or less seriously injured. Later the boar was reported to have been seen several miles beyond, still running at full speed covered with froth and foam. Caldwell says that he regards an "enraged tusker in close quarters as fully as dangerous as a full-grown tiger." On other occasions, a herd of wild pig when encountered will merely stand on the defensive or will stampede if a shot is fired. His observations on the curious nest- or "house"-building habit of these animals are interesting. These structures have given rise to much conjecture and wild stories among hunters. A "house" is usually located in some secluded level spot, and when newly constructed may cover a ten-foot square and stand four feet or more at the apex. It is made of bamboos, small bushes, grass, and ferns gathered by the builder into a heap. Caldwell says that he had examined many of these houses before finding one actually in use. This was on an early morning when, with a companion, he had worked himself into the midst of a herd in dense spruce forest. The animals were coming together after having spent the night hours feeding in the rice fields, and were making their way into a bushy tangle to spend the day. At such times it is not difficult to proceed carefully among the herd, for they make more or less noise themselves and do not take alarm at an occasional snapping twig. Coming presently upon such a well-formed "hut," the hunters stood beside it listening for the slightest sound inside, but all was still. Suddenly and without warning, the whole thing seemed to rise in their faces as three large hogs dashed out from the opposite side! The young are said to be

born in these nests, for which purpose perhaps they are constructed. A herd of wild hogs will put up a formidable defense against a leopard or a tiger, the stronger always protecting the weaker. Caldwell relates an instance of a herd of wild hog cautiously following and charging upon his spotted hound, mistaking it, as he supposed, for a leopard.

Pigs apparently breed up rapidly when undisturbed, and according to Swinhoe (1870c) were abundant in the Shanghai region at the time of his writing, where before the devastations of the Taiping Rebellion they were unknown. On the other hand they have been reduced in numbers through hunting in some sections, as in the Poyang district, which just before Heude's time he reports to have been much richer in such large game. Mell (1922) writes that in the mountain forests of southern and northern Kwangtung, pigs still occur, even in the Canton region, where there is hilly country covered with bushy jungle, but elsewhere in the province only in the Lingwu Shan and Lofau Shan. He mentions a large boar which when killed weighed 134 kilograms. Young are born in late April and early May. On May 13, he notes a sow followed by eight or nine young to a groundnut field, where several of the young were taken. The latter are said to be easily tamed, in contrast to the Yangtze pigs. Wild pigs are common in parts of the island of Hainan where there is suitable cover. Swinhoe includes them as *Sus leucomystax* in his list of mammals of the island, while more recently Mr. Clifford H. Pope secured for the American Museum a series of young and immature. In the wilder districts, he writes, they are so common as to be a pest to the farmer, and during the winter months are much hunted for food. Their flesh finds a ready market so that specimens are not easy to purchase. Natives in the wilder districts sometimes protect their fields against these raiders, or erect as amulets small pieces of cloth soaked in urine and tied to bamboo sticks stuck at regular intervals in the ground bordering the fields. While at Nodoa, Hainan, Mr. Pope secured a number of young pigs all in the striped coat, and taken in late January, February and March, hence much earlier than the breeding season mentioned by Mell (late April and May). No obvious differences are to be found between the skulls of immature pigs from the island, and those of corresponding age from the mainland.

Specimens examined:—The following forty-two:

Fukien: Chunganh sien, 3; Futsing, 1; Yenping, 11; no exact locality, 5.

Hainan: Nodoa, 19 (young); Namfong, 3 (young).

Family CERVIDÆ

DEER

The deer family comprises a number of genera, small and large, of which

some of the more primitive, such as the Musk Deer, Tufted Deer and Water Deer, are partly or chiefly confined to China and Mongolia, where they seem to have found a congenial environment and have persisted to the present time. In these same areas are larger and more progressive species, of which one, Père David's Deer, is a curiously aberrant type, no longer known in the wild state. Another, Schomburgk's Deer, with peculiar candelabra-like antlers, is nearing extinction, and is believed to have reached the extreme southern border of China. Deer agree in their slenderness of limb and relatively light build; the small lateral toes of the fore foot are present with their phalanges, but the corresponding metacarpals are reduced and lack either the upper or the lower end. In most of the genera antlers are present in the male and usually absent in the female. These are deciduous structures, grown in the summer and carried for most of the remaining part of the year before being cast, after which a new set is grown. In the more primitive deer antlers may be wanting, and their place as defensive or offensive weapons taken by the upper canines which become long, blade-like tusks. In others both these tusks and small antlers are carried, but in the larger species the canines are small or absent, and the antlers of the male may reach large proportions and great complexity of branching. The upper incisors are wanting, but the lower ones are all present, and the lower canine becomes incisiform, lying alongside the third incisor. The premolars of the upper jaw consist of a double crescent of enamel each, while the molars are of four crescents. The third lower molar has a third or accessory enamel lobe at the posterior end. Usually all the cheek teeth are short-crowned with definite short roots. Foot glands and tarsal glands are often present, and usually a prominent suborbital gland. Deer are usually fond of forest or other thick cover, and in feeding habits are largely browsers.

The Musk Deer is a somewhat aberrant member of the family, peculiar in lacking a suborbital gland and antlers in either sex, while the presence of a gall bladder is unique among existing species; these characters are believed to be reminiscent of a relation with the Bovidae, perhaps retained from a common ancestry. The lower incisors are alike in having spatulate crowns. For these reasons the genus *Moschus* is ranked as a separate subfamily in most classifications, and by some authors is even given family rank. In a study of the external characters of *Hydropotes*, Pocock has drawn attention to the presence of two small inguinal glands, and on account of its lack of antlers and the presence of large tusk-like canines in the male, would make this genus a subfamily, Hydropotinae, considering it one of the most primitive of the deer. Probably *Alces* should also be given subfamily rank on account of its laterally spread antlers, enlarged muffle, shortened nasals, lack of canines in the upper jaw, short neck, high withers, and lack of spotted pattern in the young. The other Chinese deer are members of the Cervinae or more typical deer; they are

characterized by differentiated lower incisors, antlers in the male, and either small or in some species large tusk-like upper canines, no inguinal glands, but usually a metatarsal gland. The following key will serve to indicate the obvious external characters of the genera known from China and Mongolia.

KEY TO GENERA OF CHINESE AND MONGOLIAN CERVIDÆ

- A. No antlers in either sex, but the upper canines of males forming large down-curved tusks.
 - a. Lower incisors with oval spatulate crowns all of similar shape; no suborbital gland; a large median musk gland in front of the belly in the male; liver with a gall bladder. Subfamily Moschinæ, *Moschus*
 - b. Central lower incisors with the outer corner produced and angular; suborbital and inguinal glands present; no musk gland; liver without gall bladder Subfamily Hydropotinæ, *Hydropotes*
- B. Males with antlers; upper canines either absent, small, or forming prominent tusks; suborbital glands present Subfamily Cervinæ
 - a. Size small, skull length less than 225 mm.
 - a'. Males with tusk-like upper canines; antlers simple or with a short basal snag in addition to the main beam.
 - a''. Antlers very short simple spikes, their pedicels not continued as raised ridges on the front of the skull. *Elaphodus*
 - b''. Antlers longer, with or without a basal prong and a longer beam, their pedicels continuing as raised ridges on the front of the skull. *Muntiacus*
 - b'. Males normally without upper canines; antlers with three points, the first tine coming off high up, the two others formed by the posterior fork *Capreolus*
 - b. Size large, skull length more than 225 mm.
 - a'. Lips not enlarged; main beam of antlers nearly vertical at base.
 - a''. No contrasting white patch on the buttocks; brow tine turned sharply up.
 - (a) Antlers with a strong brow tine, projecting forward and upward.
 - 1. Antlers simpler, the posterior beam forking once; tail long, reaching to hock. *Rusa*
 - 2. Antlers with the posterior beam several times forked; tail shorter. *Rucervus*

KEY TO GENERA OF CHINESE AND MONGOLIAN CERVIDÆ (Cont'd)

- (b) Antlers without a basal tine extending forward over the brow, the main beam forking well above the forehead into an anterior and a backwardly directed branch, each of which divides again; tail long, reaching the hock. *Elaphurus*
- b''. A contrasting white patch on the buttocks; brow tine extending downward and forward. *Cervus*
- b'. Lips much enlarged to form a muffle; main beam of antlers extending laterally at the base *Alces*

Genus *Moschus* Linnæus

MUSK DEER

Moschus Linnæus, Syst. Nat., ed. 10, vol. 1, p. 66, 1758.

Externally the Musk Deer are small with rather heavy limbs, the pelage coarse, consisting of brittle, quilly hairs, minutely crinkly; the tail is very short; the lateral digits have the metacarpals represented by their lower ends; there are no tarsal or metatarsal glands and no suborbital gland, but the males have a large preputial gland medially situated, which at the mating season is well developed and gives forth a substance having a strong musky odor from which musk is obtained by the Chinese. A caudal gland is also present in males. The mammæ are two pairs, inguinal. Neither sex possesses antlers, but in the male the upper canines are long and laterally compressed, projecting as tusks from the upper lips. As an exception among the members of the family, a gall bladder is present in the liver of this species. In the skull there is no depression in front of the orbit, such as often is found in deer for the reception of the suborbital gland, and this point is useful in distinguishing skulls from those of the Water Deer, *Hydropotes*. The teeth, except for the canines, are much as usual in the family, short-crowned, with three upper and three lower premolars and three molars, but the lower incisors have oval, spatulate crowns, all of similar shape. The dental formula is therefore: $i.\frac{3}{3}$ $c.\frac{1}{1}$ $pm.\frac{3}{3}$ $m.\frac{3}{3}$ = 34. Externally the Musk Deer much resembles the Chinese Water Deer, but may usually be told by its dark feet, whereas those of the latter are pale mixed buffy gray like the rest of the pelage; moreover, the tusks of the male are much more narrow and compressed.

Musk deer are found in the forested parts of eastern Asia from the limit of tree growth slightly north of the arctic circle southward to the northern

edge of Mongolia and to Korea; still farther south, avoiding the Gobi, they are present from northwestern China and Szechwan into the Himalayan region of Nepal to Gilgit. Flerov (1930) has recently reviewed the specimens available in the magnificent collections of the Zoological Museum at Leningrad, and at Moscow, and recognizes no fewer than eight different forms, including five races of *M. moschiferus* and two of *M. chrysogaster* to which the Chinese animal is referred, in addition to a third dwarf animal from western China. Most of his material was from Siberia and the Mongolian border, with but eleven Chinese specimens. Notwithstanding the conclusions reached by this painstaking investigator, it seems to me much more likely that *M. chrysogaster* of Nepal is but a race of *M. moschiferus*, while the new dwarf species named *M. berezovskii* hardly seems more than a small individual of the same animal that Buechner previously named *M. sifanicus*. I have therefore ventured to regard the latter as a race of *M. moschiferus*, the type species, and to include *M. berezovskii* for the present as a synonym of it, believing it to be but an undersized animal. Lack of comparative material from Nepal renders difficult any complete understanding of the relationships of the Himalayan and Siberian animals, but the ranges are practically continuous or have been broken only by human persecution.

KEY TO CHINESE AND MONGOLIAN RACES OF *Moschus*

- A. Color dark chocolate brown, with or without indistinct white spots; lachrymal bone higher than long. *M. moschiferus moschiferus*
- B. Color more buffy; muzzle slightly longer, lachrymal longer than high. *M. moschiferus sifanicus*

472. *Moschus moschiferus moschiferus* Linnæus

Moschus moschiferus Linnæus, Syst. Nat., ed. 10, vol. 1, p. 66, 1758. Milne-Edwards, Recherches pour servir à l'Hist. Nat. des Mammifères, p. 176, pl. 19, 1868-74. Lydekker, Cat. Ungulate Mamm. Brit. Mus., vol. 4, p. 4, 1915.

Moschus moschiferus sibiricus Flerov, Annuaire Mus. Zool. Acad. Sci. URSS, vol. 31, p. 5, 1930 (in part).

Type specimen.—Linnæus's name is based on a specimen described by Grew, formerly in the Museum of the Royal Society of London, and referred to by Ray. The locality is given as "Tatari versus Chinam," implying perhaps northwestern Mongolia.

Description.—Various descriptions of the anatomy of this deer have been published, such as that by Milne-Edwards (1864, pp. 55-79) with a history of

the animal, and those of W. H. Flower (1875) on the structure, and F. J. Bell (1876) on the limb muscles.

Two specimens in the spotted phase, taken in late August, are changing from winter to summer coat, one of them having the new pelage short and dark grayish-brown (Prout's brown) with a tuft of the stiff hairs of the caudal region still present; the other (August 24) with the new hairs just beginning to show in small patches on the withers and flanks, and of a much darker shade than the old faded brown of the longer winter coat. In this phase the white spots are arranged in four (more or less) lengthwise series on each side of the body, and are formed by the concentration of hairs having a whitish subterminal band, clustered together to make a spot. Individual hairs are pale whitish at base, becoming drabby brown in the distal half, with a minute subterminal white band. On the head and neck these hairs are evenly disposed, resulting in a general grizzled pattern, which continues over the shoulders and lower throat to the belly. The upper throat and chin are white, rather sharply bordered posteriorly by the darker color. A narrow white line begins about a centimeter behind this border at each side of the throat and passes back along the lower side of the neck. The belly is a slightly paler, grayer tint than the flanks. The legs are mixed dark brown and gray, the fore legs sometimes nearly clear dark brown.

The skull is lightly built, and in profile shows a decided convexity over the posterior part of the orbit. The lachrymal bone is subtriangular in outline, its posterior edge forming the anterior border of the orbit. Its greatest height vertically exceeds its greatest length taken from the middle of the orbital border. The nasals are long and slender, nearly of the same width throughout. A vacuity occurs in the bony wall between them and the lachrymal, but there is no depression for a gland. In ventral view a deep notch extends forward to near the level of the front of the last molar, so that the median part of the palate is produced backward in tubular form. The upper canines are, in the male, long and slightly convex forward, narrow, with a sharp posterior edge. In the female they are small and so short as hardly to more than pierce the gums. The premolars are three, the upper ones consisting of an outer and an inner crescent-shaped cusp, while the molars consist of two such paired sections. The lower incisors have the crowns flattened and evenly oval in outline, and the crowns of the two lower canines are quite similar.

Measurements:—The typical variety is apparently larger than the race of China, but no flesh measurements or weights are available.

For skull measurements, Flerov has assembled an excellent summary table of maximum and minimum dimensions. To these may be added the following:

CRANIAL MEASUREMENTS OF *MOSCHUS*

No.	Greatest length	Condylobasal length	Basal length	Palatal length	Orbit to tip of premaxillæ	Nasals, median length	Zygomatic width	Mastoid width	Width outside molars	Upper cheek teeth	Lower cheek teeth	Lachrymal (length x width)	Locality
<i>M. moschiferus moschiferus</i>													
46405	150	144	134	91	76	56	70	40	45.0	42.0	47.0	15.0x20.5	Mongolia
46406	150	144	135	89	75	56	66	40	46.5	42.0	47.0	15.5x20.0	Mongolia
<i>M. moschiferus sifanicus</i>													
57078	142	130	121	79	69	47	63	37	43.0	40.5	44.5	18.0x17.0	Shensi
13272 MCZ	154	142	131	87	82	56	67	38	45.0	48.0	51.0	22.0x18.5	Szechwan

Occurrence and Habits:—In his review of the Musk Deer, Flerov (1930) regards the range of the typical race as including the "mountains of central and western Siberia," extending to northwestern Mongolia, but refers specimens from the Kentai Mountains of northeastern Mongolia to the race *M. m. sibiricus*, which is said to be smaller in its cranial dimensions. The two specimens listed above, a male and a female, adult, are, however, within the limits assigned by him to the typical race, and are probably best referred to it. They were secured by Dr. R. C. Andrews forty-five and sixty miles northeast of Urga, respectively, hence not far from the supposed southern limit of *M. m. sibiricus*. Flerov lists two specimens from northwestern Mongolia and three from the Kentai Mountains. Evidently the range is continuous along the forested edge of northern Mongolia and around the eastern edge of the Gobi to Hopei. I have seen no specimens from the latter area, but Milne-Edwards (1868-74, pl. 19) has described and beautifully figured a Musk Deer obtained in the mountains near Peiping by M. Fontanier, probably about 1867. It shows the indistinct pattern of spots and broken pale stripes usual in this race, and no doubt to be regarded as the retention of a primitive trait, common to the young as well. At the present time it is probably rare in Hopei so keenly is it pursued by Chinese hunters for the musk "pod," which is said to be most odoriferous at the mating period. Sowerby (1925i) mentions that it is found in northeastern Hopei, and is essentially a forest and cliff-dwelling animal, usually solitary in habits except during the rut. Möllendorff (1876) quotes a Chinese writer of the eighteenth century to the effect that it was then common in the mountains west of Peiping, but Heude's (1894a) statement that it is still found in the high mountains of Chouki, Chekiang, though probably correct, requires confirmation.

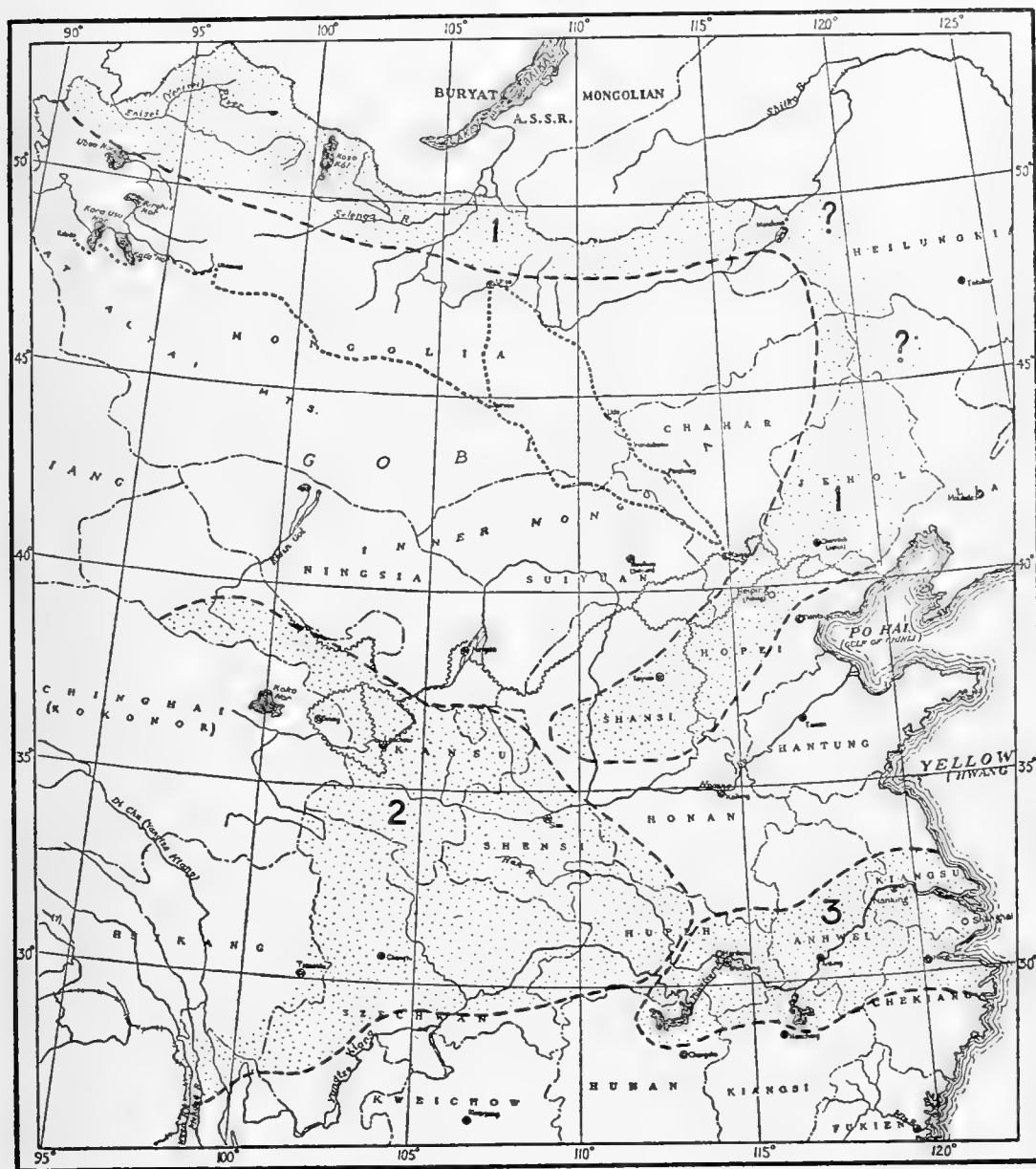


FIG. 63. Distribution Map.

*Moschus*1. *M. moschiferus moschiferus**Hydropotes*2. *M. moschiferus sifanicus*3. *H. inermis inermis*

Intergradation with the southwestern *M. sifanicus* seems so likely that I have ventured to differ from Flerov, and consider *sifanicus* but a subspecies of *M. moschiferus* instead of a distinct species or, as he would call it, a subspecies of *M. chrysogaster* of Nepal.

Specimens examined:—The following three:

Mongolia: forty to forty-five miles northeast of Urga, 2 skins and a skull; sixty miles northeast of Urga, 1 skin and skull.

473. *Moschus moschiferus sifanicus* Buechner

Moschus sifanicus Buechner, Bull. Acad. Imp. Sci. St. Pétersbourg, vol. 34 (new ser., vol. 2), p. 116 (Mélanges Biol., vol. 13, p. 162), 1892.

Moschus moschiferus Milne-Edwards, Recherches pour servir à l'Hist. Nat. des Mammifères, pl. 20, 1868-74.

Moschus moschiferus sifanicus Lydekker, Cat. Ungulate Mamm. Brit. Mus., vol. 4, p. 7, 1915. G. M. Allen, Amer. Mus. Novitates, no. 430, p. 8, 1930.

Moschus berezovskii Flerov, Compt. Rend. Acad. Sci. URSS, 1928A, p. 519; Annuaire Mus. Zool. Acad. Sci. URSS, vol. 31, p. 10, pl. 6; pl. 7, figs. 7, 8, 1930. Lungan, Szechwan.

Moschus chrysogaster sifanicus Flerov, Annuaire Mus. Zool. Acad. Sci. URSS, vol. 31, p. 8, pl. 5; pl. 7, figs. 5, 6, 1930.

Type specimen:—A skin and skull of an adult male, No. 3154, collection of the Zoological Museum of the Academy of Sciences, Leningrad, U.S.S.R., from southern Kansu, China. Collected by N. Przewalski, 1884-87.

Description:—In the "concolor" type figured by Milne-Edwards and represented by a large percentage of specimens, the pattern of whitish spots and stripes is obsolete or lacking except in the young, and the entire pelage is mixed yellowish brown. Muzzle, forehead and nape, finely ticked white and dark brown, and the backs of the ears the same. Inner side of the ears lined with long buffy hairs. General color of back and sides buffy to golden brown, the individual hairs pale drab at base, with a narrow subterminal band of dark brown (Prout's brown) tipped with warm buff. The sides are less dark and more golden than the mid-dorsal area. On the fore part of the chest the long quilly hairs are drab with a long buffy tip, just below which the dark-brown ring is not strongly contrasted. Belly hairs similar, but just back of the axilla there is an area of orange-buff hairs of the same tint throughout. The fore legs are pale buffy mixed with pale brown, but the latter color is less evident distally, and absent almost entirely on the inner side of the leg, which is therefore pale buffy in the distal half with tufts of dark-brown hair between the toes. The hind legs are similar, except that the inner side is brighter, nearly orange buff. The supposed differences in the ear of this race, as compared with the typical form, appear to be invalid, for they are not longer nor essentially different in color pattern, although a trifle brighter orange ochraceous instead of buffy internally. The spotted and striped condition does occur, possibly as a retention of the youthful condition, in specimens from Kansu and southward, but the uniformly colored condition seems to be the more usual. Doubtless it was such spotted individuals that Buechner in his report of 1892 referred to the typical *M. moschiferus*.

The skull of this musk deer is slightly more slender and even longer of muzzle than in the latter, and the molar teeth may be even larger. The

lacrimal bone averages longer antero-posteriorly than high, instead of the opposite. In all these points, however, there is more or less variation.

Measurements.—Measurements of a specimen secured by W. R. Zappey at Shuowlow, western Szechwan, are: total length, 860 mm.; tail, 40; hind foot, 270; height at shoulder, 525; height at hips, 540.

For cranial measurements of this and another specimen, see table under the typical race.

Nomenclature.—The Gobi, intervening between the range of the northern races and the southern, does not, however, completely cut the latter off, and the distribution is, or was, continuous around the eastern side of the Mongolian plateau. While it is true that the "concolor" type of this deer is the prevalent one to the south of the Gobi, the spotted-and-striped types also occur, even to Nepal, so that it seems most reasonable to assume, as Lydekker has done, that the animals to the south are but geographic races of the type found north of the desert, rather than distinct species as advocated by Flerov. It remains to be shown how different the Kansu and Szechwan musk deer are from that of Nepal, to which Hodgson gave the names *M. chrysogaster* and *M. leucogaster*, although it is assumed that they are racially distinct. Flerov has described as a distinct species a very small, yet apparently adult, male from near Lungan, northern Szechwan, calling it *Moschus berezovskii*. A second specimen from the same locality is, however, of the size of *M. sifanicus*, so that Flerov is forced to conclude that the small type is an inhabitant of barren plateaus at higher altitudes. It seems much more probable that it was really but a "runt" or stunted individual, such as may often be seen among other species of deer, and does not represent a different specific type. I have therefore relegated the name to the synonymy of *M. m. sifanicus*.

Occurrence and Habits.—Musk Deer are still found in small numbers in rough, scrubby country across southern Shansi, Shensi, and Kansu. Lydekker (1915) records a specimen in the British Museum from Ichang, Hupeh, which must represent nearly the eastward limit of the range in the Yangtze basin. In the highlands of Szechwan it occurs at least as high as 14,000 feet, at which altitude, near Shuowlow, W. R. Zappey secured a specimen for the Museum of Comparative Zoölogy. A. B. Howell (1929) records others in the U. S. National Museum from Taochow and Archuen (Min Shan), Kansu. Pou-sargues (1898b) long ago recorded their presence in the Nan Shan on the authority of David, as well as from the Alashan westward to the Tibetan border. Dr. R. C. Andrews secured a skull from near the base of Taipai Shan, Shensi, and A. B. Howell (1929) notes a second from that place in the U. S. National Museum. The records are few for Szechwan, but Jacobi (1922) has notes on

four secured by the Weigold Expedition from Taukwan, and a skull from Tatsienlu. It is found also on Wa Shan and westward to eastern Tibet. Jacobi states that the skins of these specimens were of the uniformly colored type except those of immature animals which showed traces of the spotted pattern. Weigold found them in primeval fir forest with undergrowth of alpine roses, as well as in scrub growth of rhododendrons in the alpine zone. Solitary and shy, these much-persecuted little animals will often make their way along the trunk of a fallen tree, or even one sharply bent over, to take refuge in the thick top. The native hunters, taking advantage of this habit, often catch them by setting a jerk-up snare on the leaning trunk. According to Sowerby (1923g), the snare is universally used by the Chinese in capturing the musk deer for its musk gland. "A little hole is dug in a path that is known to be frequented by musk-deer, and a little wooden platform is set in this in such a way as to hold down a trigger. The trigger is attached to a noose which lies lightly round the hole, its other end being attached to a convenient sapling that is bent over and held so by the trigger. When the musk puts its foot on the platform the trigger is released, the sapling straightens, drawing tight the noose around the animal's leg and jerking the poor little creature into the air. . . . This is at once a brutal and wasteful method, for females and young males, which have not yet developed musk-pods, are indiscriminately caught along with the old males (over three years) which alone are of any value.

"In Shansi, North China, where the musk-deer is plentiful in the forested mountainous areas, the hunters will not tolerate this method, resorting to driving and shooting; which . . . ensures that only the males with musk-pods are taken." Sowerby adds that the flesh is not considered very good, but the hide makes a strong leather. On the other hand, E. H. Wilson (1913) describes the meat as excellent, equal to the best muntjac. He tells of a local chief at Tatsienlu, who kept several of these deer in an enclosure, where they appeared to be happy and contented, and were even said to breed in this captive state. He speaks of their habit of ascending leaning tree trunks, aided by their sharp narrow hoofs, to hide in the dense top. Wilson quotes Hosie, giving figures to show the value of the musk annually exported from Tatsienlu, amounting in the year quoted to over 24,500 ounces valued at 300,000 taels. Smaller quantities are exported through Kwanhsien (16,000 ounces) and Sungpan.

There seems to be little information as to the presence of the Musk Deer in Yunnan, beyond general statements that it is found at higher levels to the western edge of forest on the Tibetan borders. Pousargues (1896a) mentions that the Prince d'Orléans, on his journey through western Yunnan, found it, but no particulars are given. Doubtless, however, the range is nearly or quite continuous across the rough country to the mountains of Nepal.

Specimens examined:—The following three:

Shensi: base of Taipai Shan, 1.

Szechwan: Shuowlow, 14,000 feet, 1 (M.C.Z.).

No exact locality, 1.

Genus **Hydropotes** Swinhoe

Hydropotes Swinhoe, Proc. Zool. Soc. London, 1870, p. 89. Pocock, Proc. Zool. Soc. London, 1910, p. 956;

ibid., 1923, p. 192 (not *Hydropota* Rondani).

Hydrelaphus Lydekker, Deer of All Lands, p. 219, 1898. Trouessart, Cat. Mamm. Viv. Foss., p. 691, 1904.

This is a small, harsh-haired deer without antlers in either sex, and belongs in the section Telemetacarpalia in which the lateral metacarpals are represented by their lower ends as in the American White-tailed Deer. A small suborbital gland is present, sunk into a deep oval depression of the lachrymal bone, but there are no tarsal or metatarsal glands. There is a gland between the digits of the hind feet but none in the fore feet. The tail is a short stump. The ears are rather small, with an abundant hairy lining and two cartilaginous ridges on the inner side at the base. Four (? or two) mammae are present, and there is a small inguinal gland on each side, situated in a nearly naked area of skin and present in both sexes, the only instance known of such glands in the Cervidae. The penis is simple and slightly attenuate, without filiform outgrowths, and with the opening terminal. In the skull the upper canine is enlarged as a long, slightly curved tusk in the males, and much smaller in the females. It is laterally compressed, convex on the outer face and flat on the inner, with the edge posterior. The molars are practically without the short supplementary pillar in the valley between the two transverse pairs of cusps, although in some cases individual teeth show a mere trace of a column here. The upper ends of the premaxillae are strongly in contact with the outer ends of the nasals, and these latter are but barely expanded at the proximal ends. The audital bulla is unusually large and inflated. Unlike the American deer, the vomer does not extend posteriorly to the edge of the palate to divide the nasal passage. Garrod showed that the cuneiform bones are not united with the naviculo-cuboid as they are in *Muntiacus*; hence he did not believe that the two genera are nearly related. On the other hand, *Hydropotes* resembles *Capreolus* and differs from other Old World deer in retaining the distal ends of the lateral metacarpals. Pocock believes that it is the most primitive of existing Cervidae in lacking antlers and having in their place the enlarged upper canines in the male; it retains the preorbital gland but has lost the metatarsal gland, and is unique among the members of the family in having inguinal glands. On account of these and other peculiarities, Pocock would make it the type of a special subfamily, Hydropotinae.

In addition to the well-known *H. inermis* which seems at the present time to be confined to the flat country along the lower Yangtze River, another form

has been named from Korea, *H. argyropus*, the status of which has for some time remained problematical, for since its first discovery and naming by Heude, few others have reached museums, and it has even been suggested that some other species was mistaken for this genus. More recently, however, the U. S. National Museum has acquired additional specimens from Korea, in recording which, A. B. Howell (1929) has given the animal subspecific standing. The wide gap between the distributional areas of the two races, so far as at present known, may be a result of extermination and the deforestation of the intervening country.

474. *Hydropotes inermis inermis* Swinhoe

CHINESE RIVER DEER

Hydropotes inermis Swinhoe, Proc. Zool. Soc. London, 1870, p. 89. Lydekker, Cat. Ungulate Mamm. Brit. Mus., vol. 4, p. 257, 1915. Pocock, Proc. Zool. Soc. London, 1923, p. 192.

Hyelaphus porcinus Swinhoe, Proc. Zool. Soc. London, 1865, p. 510 (not of Zimmermann).

Hydropotes affinis Brooke, Proc. Zool. Soc. London, 1872, p. 524.

Hydrelaphus inermis Lydekker, Deer of All Lands, p. 221, pl. 17, fig. 2, 1898. G. M. Allen, Mem. Mus. Comp. Zool., vol. 40, p. 205, 1912.

Hydropotes kreyenbergi Hilzheimer, Zool. Anzeiger, vol. 29, p. 298, 1905; Abh. u. Ber. Mus. f. Natur- u. Heimatk., Magdeburg, vol. 1, p. 171, pl. 2, 1906. Chinkiang, Kiangsu.

Type specimen.—A male, skin and skull, No. 70.7.18.15, British Museum, from an island in the Yangtze near Chinkiang, Kiangsu, China. Purchased in the Shanghai Market by Robert Swinhoe, November 30, 1868.

Description.—A small, harsh-haired deer lacking antlers, but with large canines in the male, and with a very short stump of a tail. The hair is longest on the flanks and rump, about 40 mm. in winter coat, shortest on the muzzle. The edge of the upper lip and the middle of the rostrum as far back as the level of the eyes are grizzled gray. Forehead, occiput, sides of the face and backs of the ears buffy with a tint of brown, due to the brown bases of the hairs (drab to seal brown) which are tipped with pale ochraceous. Backs of the ears nearly clear ochraceous buff; a clear area around the upper eyelid is nearly white at the anterior upper corner of the eye, becoming buffy posteriorly. Chin and upper throat whitish to buffy, the lower throat becoming tinged with drab as the pale-brownish bases of the hairs show through. Back and sides of the body nearly uniform in color, the long quilly hairs pale or grayish at base with a subterminal ring of dark brown and a buffy tip, giving a yellowish-brown tint, slightly brighter in the center of the back and clearer buffy at the sides through the gradual disappearance of the brownish ring. Center of the belly and the inguinal region white to the bases of the hairs, with a faint tinge of pale buffy. Fore feet from the carpus and the hind feet from the hock clear ochraceous to the hoof, varying slightly in depth. Lateral hoofs well developed, about 15 mm. long.

The young are marked with white spots and stripes.

The chief features of the skull have already been mentioned: the lack of horns, the enormous upper canines, the deep small pit in the lachrymal, the narrow nasals, scarcely expanded behind, and the large inflated bullæ. The palate is deeply notched on each side of the posterior nares to the level of the front of the third molar. The upper molars occasionally show a minute trace of an inner column of enamel at the bottom of the valley separating the two inner cones.

Measurements.—The following measurements were made in the field by W. R. Zappey, who obtained the series for the Museum of Comparative Zoölogy in 1908 at Kwangtitzze, Hupeh.

No.	Total length	Tail	Hind foot	Height at shoulder	Height at croup	Sex
11526 MCZ	915	75	265	530	540	♂
11527 MCZ	1030	75	280	—	—	♂
11532 MCZ	980	62	260	—	—	♂
11534 MCZ	830	62	242	450	470	♂
11535 MCZ	890	62	250	460	485	♂
11536 MCZ	970	60	275	530	550	♂
11537 MCZ	930	55	265	505	525	♂
11538 MCZ	1025	65	270	550	580	♂
11528 MCZ	920	65	260	510	530	♀
11529 MCZ	950	70	270	500	—	♀
11530 MCZ	920	60	265	490	505	♀
11531 MCZ	980	75	265	480	—	♀
11533 MCZ	880	55	270	—	—	♀
11539 MCZ	940	75	272	515	540	♀

CRANIAL MEASUREMENTS OF *HYDROPOTES*

No.	Greatest length	Basal length	Palatal length	Zygomatic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Orbit to rostrum	Sex	Locality
57105	153	142	90.0	66.0	44.0	46.0	48.0	—	82.0	♂	Hunan
11526 MCZ	149	144	87.0	62.5	47.2	47.0	46.6	50.5	75.5	♂	Hupei
11527 MCZ	169	149	102.0	72.0	48.8	51.2	46.2	50.5	83.7	♂	Hupei
11532 MCZ	165	144	93.5	66.4	—	48.3	48.5	53.7	80.5	♂	Hupei
11538 MCZ	166	154	98.0	70.5	49.6	50.0	49.7	53.5	87.0	♂	Hupei
11536 MCZ	162	142	96.0	66.4	46.3	46.7	48.0	54.3	80.5	♂	Hupei
20009 MCZ	166	146	97.5	74.2	50.6	52.6	48.2	53.6	84.5	♂	Chekiang
20012 MCZ	162	—	—	66.7	46.7	47.7	46.8	—	81.5	♂	Chekiang
24082 MCZ	170	152	104.0	76.0	52.6	52.3	49.5	53.8	87.6	♂	China
11528 MCZ	159	142	93.5	63.7	46.7	47.8	50.2	55.5	80.5	♀	Hupei
11529 MCZ	157	138	87.0	60.7	48.7	46.5	48.0	51.6	76.4	♀	Hupei
11530 MCZ	157	140	92.0	67.2	48.1	47.6	45.6	51.5	76.7	♀	Hupei
11531 MCZ	159	140	94.5	66.9	47.3	49.8	48.8	53.0	77.5	♀	Hupei
11539 MCZ	160	140	93.0	65.0	49.0	48.4	49.0	51.8	79.3	♀	Hupei
16023 MCZ	159	142	92.0	68.6	50.6	49.5	47.0	51.5	76.7	♀	Hupei

The average weight is from twenty to twenty-four pounds (E. H. Wilson, 1913).

The upper canines in the male reach a length of about 52 mm. in a straight line from the tip to the inner base; those of the female are much smaller, scarcely 5 mm. on the inner side. They are somewhat loosely implanted in a socket which is considerably wider at its mouth than the diameter of the tooth, and may become therefore slightly movable.

Nomenclature.—Swinhoe (1865) in first writing of this deer believed it to be the Hog Deer, and speaks of it as *Hyelaphus porcinus*; five years later, recognizing his mistake, he described it as a new genus and species, *Hydropotes inermis*, from a specimen taken at Chinkiang. In 1872 Sir Victor Brooke published an account of the cranial characters, and called it, perhaps inadvertently, *Hydropotes affinis*, but the name is clearly a synonym. The name *Hydropotes* was changed to the new name *Hydrelophus* by Lydekker in 1898 on the ground that the former was preoccupied by *Hydropota* of Rondani, 1861, a genus of Diptera; but the International Rules regard the two as distinct, so that the change became unnecessary, as Hilzheimer (1905a) pointed out. This author at the same time bestowed the new name *Hydropotes kreyenbergi* upon a skull also from Chinkiang, a name evidently synonymous with *H. inermis*, as Matschie (1908) soon after recognized.

Occurrence and Habits.—This small brownish-yellow deer was first made known by Swinhoe in 1870. He wrote that it was common on the large islands in the Yangtze River above Chinkiang, living among the growth of rushes. These are cut in spring, and the deer then leave for the main shore and the cover of the adjacent hills, returning with their young in the autumn when the new growth of rushes again furnishes shelter. He had previously (1865) mentioned the species as *Hyelaphus porcinus*, noting their concentration at high water on an island near Chinkiang. The same writer states that in the winter of 1872-73 these animals were so abundant around Shanghai that the market was glutted with them, and their carcasses sold for 4s. 6d. each. They are usually started singly, but he knew of an instance when a herd of twenty was put up in the great marsh beyond Hangchow Bay sea-wall near Fenghsien, the region whence Shanghai gets most of its game. From the region of the mouth of the Yangtze, the range extends westward in the river valley to Hupeh, nearly to the Ichang Gorge. Sowerby (1924b, 1926a) says that they are common along the Yangtze in the Nanking and Chinkiang districts to beyond Wuhu, and though less common than formerly, have been lately taken in these places and in Soochow and Wusi. The Central Asiatic Expeditions brought back specimens from Yochow, Hunan, as well as from Tunglu, Chekiang,

while Dr. F. R. Wulsin collected two fine males at Ningpo, Chekiang, for the Museum of Comparative Zoölogy.

Although this animal particularly seeks refuge in the beds of tall reeds along the river, it may also be found on mountain sides, cultivated areas, or even in the long grass of graveyards. E. H. Wilson (1913), who hunted them in the neighborhood of Shasi, a short distance east of Ichang, wrote that many thousands are sold as food each year. They are adepts at hiding, and any cover seems sufficient to give them shelter. Although not averse to water and swamps, they prefer drier land. An ideal spot for finding them is in long grass on rising ground near reed-grown swamps. When by midwinter the cover is mostly cut, they will even be found lying in the furrows and hollows of open fields.

A remarkable peculiarity of this deer is the fact that, unlike most deer which usually have but one or two young, the River Deer may have five or six in a litter. This was first reported by Swinhoe, in 1870, who gave it on the authority of a friend that he had seen six embryos in a female which had been shot. Hamilton (1871a) confirmed this on the report of Mr. T. Annett, who had "constantly found five and six foetuses in the doe." In 1873 Swinhoe mentioned that in two females killed that winter by a friend, there were in each seven embryos, though four, five, or six seem to be usual. Hamilton (1873) also reports a case of seven young, perhaps from the same source. This prolificness may in part account for the fact that it is still fairly numerous in the Yangtze valley. It is said by Swinhoe to be eaten by Europeans only, as the Chinese "have an extraordinary dislike for the flesh," probably superstitious. The meat is said to be dark but not particularly inferior, and according to E. H. Wilson, much superior to the beef obtainable along the river.

A living specimen of this deer was sent by Swinhoe to the Zoological Society of London in 1873, and in the following year a female (Proc. Zool. Soc. London, 1873, p. 517; *ibid.*, 1874, p. 110). Cornely (1877) reported the birth of three young in captivity, one of which was born dead and subsequently was studied by Garrod who stated that there were four mammæ. Pocock (1923), however, found but two in a specimen he examined. It seems probable that Garrod was right, and that four is usual, for a skin of a female that I examined clearly had four. Possibly the number is subject to some variation, but it is difficult to see how a family of four to seven young could survive if there were but two mammæ regularly. The young are born in May.

Sowerby (1923e) reports what he supposes to be a River Deer from Suyih sien on Hungtze Lake, northern Anhwei, but the height at the shoulder given by his informant—30 inches—seems rather large for this animal.

Specimens examined:—The following twenty-six:

Kiangsu: Chinkiang, 1.

Chekiang: Tunglu, 2; Ningpo, 2 (M.C.Z.).

Hunan: Yochow, 3.

Hupei: Kwangtitzze, 18 (M.C.Z.).

Genus *Elaphodus* Milne-Edwards

TUFTED DEER

Elaphodus Milne-Edwards, in David, Nouv. Arch. Mus. d'Hist. Nat. Paris, vol. 7, Bull., p. 93, footnote, 1871.

Milne-Edwards, Recherches pour servir à l'Hist. Nat. des Mammifères, p. 353, 1868-74. Lydekker, Cat.

Ungulate Mamm. Brit. Mus., vol. 4, p. 34, 1915.

Lophotragus Swinhoe, Proc. Zool. Soc. London, 1874, p. 452.

The Tufted Deer is confined mainly to China, and in general appearance recalls a muntjac, except that the antlers are mere points nearly concealed by the tuft of long hair on the forehead; the lateral hoofs are small but well developed with somewhat crescentic cross-section. The eye is smaller than in the muntjac; the upper canine in males, although enlarged and compressed to form a tusk, is not turned outward at the tip; there is a prominent suborbital gland; but the antler pedicels are not continued down on to the frontals as raised ridges. Other obvious cranial differences are: the expanded upper end of the premaxillary, which is in contact with the anterior part of the nasal; the steep sides of the muzzle so that the posterior wings of the nasals turn down at nearly right angles to the bridge of the nose; the large and deep pit for the reception of the suborbital gland, the long diameter of which, instead of being more or less parallel with the long axis of the skull, is tilted up at a considerable angle; the bony orbit smaller than the suborbital pit in diameter; and the continuation of the interpterygoid fossa forward nearly to the level of the lateral notches of the posterior palate, or the palate may be continued as a partly roofed-over tube behind the molar level. Frontal glands are lacking. Tarsal bones as in *Muntiacus*, the external and middle cuneiform uniting with the naviculo-cuboid in a single mass.

This genus, as Lydekker points out, is "evidently less specialized than *Muntiacus*" to which it is related, and is represented by but a single species ranging from Yunnan to the coast of southeastern China. In addition to the typical race of Szechwan and Yunnan, three other subspecies have been named, but the characters upon which they rest are poorly defined, and it is probable that only one or two races are valid, for specimens of the species are so few in museums that it is not as yet certain what the limits of individual variation are. Probably the small coastal race is worthy of recognition (*E. c. michianus*), but whether an intermediate form (*E. c. ichangensis*) is sufficiently distinct to merit separation is still uncertain. Awaiting further light on this point,

I have included it, but have placed *E. c. fociensis* of Fukien in the synonymy of the former.

The following key expresses these differences:

KEY TO CHINESE RACES OF *Elaphodus*

- A. Size large, skull length over 180 mm.; color dark chocolate brown..... *E. cephalophus cephalophus*
- B. Size smaller, skull length less than 180 mm.; color grayer.
 - a. Nasals narrower, laterally compressed in the posterior portion..... *E. cephalophus michianus*
 - b. Nasals less narrowed, less compressed posteriorly..... *E. cephalophus ichangensis*

475. *Elaphodus cephalophus cephalophus* Milne-Edwards

Elaphodus cephalophus Milne-Edwards, in David, Nouv. Arch. Mus. d'Hist. Nat. Paris, vol. 7, Bull., p. 93, footnote, 1871. Milne-Edwards, Recherches pour servir à l'Hist. Nat. des Mammifères, p. 353, pls. 65-67, 1868-74.

Elaphodus cephalophus cephalophus Lydekker, Cat. Ungulate Mamm. Brit. Mus., vol. 4, p. 35, 1915. G. M. Allen, Amer. Mus. Novitates, no. 430, p. 9, 1930.

Type specimens.—The original description was based on a male and a female sent by Père Armand David from Muping, Szechwan, China, to the Paris Museum about 1870. These are presumably still in the collection of that institution.

Description.—Darkest of the races and largest. General color above, "chocolate-brown," very dark, almost blackish in winter, more rufous in summer; paler and slightly mixed with pale-ticked hairs on the sides of head and about the muzzle. Inguinal region and under side of the tail pure white; a tuft of hairs at the outer base of the ears, the long sparse hairs of the inner side and the outer tips of the ears, white. Milne-Edwards has given excellent figures of the exterior of the female cotype and of the skull of the male cotype. The former is in the more rufous summer coat, as pointed out by Thomas (1912e).

Skull rather slender, the muzzle deep, with nearly vertical sides. A distinct depression is seen in profile view above the front of the orbit. Nasals large, comprising about a third of the occipito-nasal length. The short, slender pedicels of the antlers, surmounted by very short, stumpy points, curve inward slightly, and are present in males only. The upper canine in the male is large and compressed, with a sharp posterior edge, and slightly everted long axis.

The young show a trace of the spotted pattern, with a row of "not very distinctly marked white spots" on each side of the median line of the back, and outside that again, a trace of another row. Elsewhere the coloring is dark brownish as in the adult.

The milk premolars in these deer are retained for a long time. Thus in two skulls in which the basal sutures are closed, and with the last upper molar in one just beginning to wear, they are still in place and functional.

Measurements.—No flesh measurements of the typical race are at hand. Milne-Edwards gives for an adult female, cotype, in the Paris Museum: height at withers, 490 mm.; trunk, from breast to anus, 580; tail, 120; ear, 80.

CRANIAL MEASUREMENTS OF *ELAPHODUS*

No.	Condylor- basal length	Basal length	Pala- tal length	Zygo- matic width	Mas- toid width	Orbit to tip of pre- max- illæ	Width out- side molars	Upper cheek teeth	Lower cheek teeth	Sex	Locality
<i>E. cephalophus cephalophus</i>											
MILNE-EDWARDS (type)	182.0	—	—	86.0	—	—	—	—	—	♂	Szechwan
43060	190.0	181.0	121	88.0	61.0	104.0	66.0	58.0	66.0	♀	Yunnan
<i>E. cephalophus ichangensis</i>											
11542 MCZ	176.5	168.4	116	85.5	51.2	94.0	61.2	54.5	61.3	♀	Hupeh
55983	—	—	—	80.0	50.0	—	59.0	59.0	66.3	♂	Szechwan
84356	175.0	170.0	118	78.3	51.7	94.6	53.0	57.5	—	♀	Szechwan
<i>E. cephalophus michianus</i>											
84462	—	—	—	81.0	49.0	—	58.0	59.0	64.0	♂	Fukien
84463	175.0	165.0	107	79.0	49.0	97.0	57.0	59.5	66.0	♂	Fukien
6277 MCZ	—	—	—	—	48.0	—	—	58.0	60.0	♂	Chekiang
6278 MCZ	170.0	161.0	108	77.0	50.3	94.0	55.0	54.3	61.0	♀	Chekiang

Occurrence and Habits.—This, the largest race of the Tufted Deer, is confined to the highlands of southwestern China. The original specimens were secured by Père Armand David in or near the Muping region of central Szechwan. The British Museum has a skin and skull from Wenchwanhsien, Si Ho valley, western Szechwan, and another from still farther west, in eastern Tibet near the Szechwan border at 15,000 feet altitude. Jacobi (1922) records specimens secured by the Weigold Expedition at Taukwan, Tatsienlu, and Batang in western Szechwan, where they are found from the valley jungles up into the mountain forests. In light cover they will stand motionless and easily escape observation, but are more readily seen in winter against the snow. The American Museum Asiatic Expeditions under Dr. Andrews secured an adult female in the Likiang Range of northwestern Yunnan in 1916, while a still farther extension of the known range is made by Sowerby (1926b) who records one killed by Captain E. Maxwell West on the northwest frontier between China and Burma. To the northward, there are no records

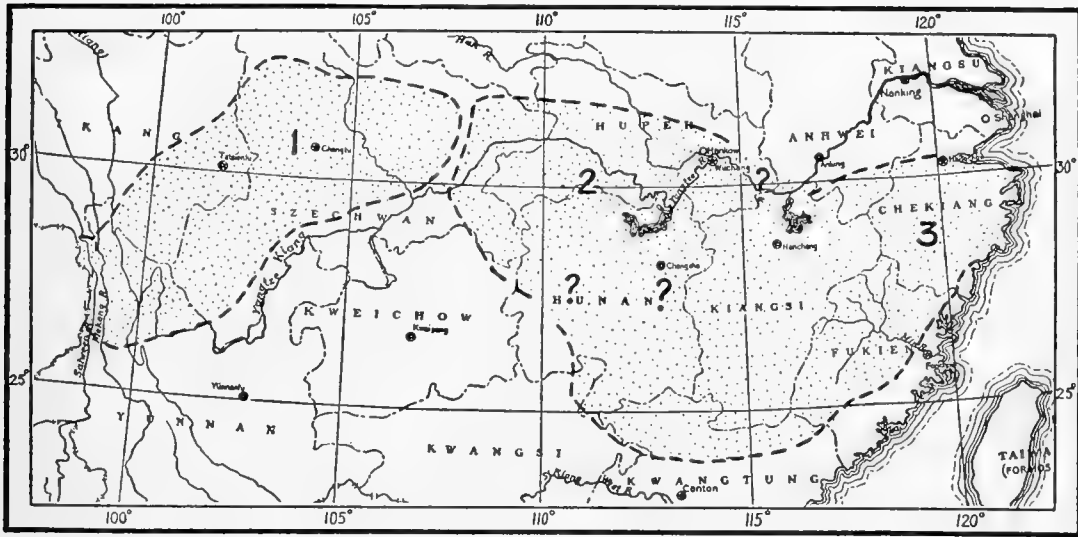


FIG. 64. Distribution Map.

Elaphodus

1. *E. cephalophus cephalophus* 2. *E. cephalophus ichangensis* 3. *E. cephalophus michianus*

beyond the latitude of the Si Ho valley, mentioned above. Here, according to M. P. Anderson, the animal was found to be "very shy and retiring, but not really rare." Dr. R. C. Andrews met with this deer on the Snow Mountain of the Likiang Range, and described its appearance in full bound before a pursuing dog, with "its white flag standing straight up over its dark bluish back."

Specimens examined:—One, from Likiang, Yunnan.

476. *Elaphodus cephalophus ichangensis* Lydekker

Elaphodus ichangensis Lydekker, Abstract Proc. Zool. Soc. London, June 14, 1904, p. 10; Proc. Zool. Soc. London, 1904, vol. 2, p. 169.

Elaphodus cephalophus ichangensis Lydekker, Cat. Ungulate Mamm. Brit. Mus., vol. 4, p. 39, fig. 9, 1915.

Type specimen:—A male, skin and skull, No. 1.3.2.17, British Museum, from Ichang, western Hupeh, China. Collected by F. W. Styan about 1901.

Description:—The characters given by the describer of this deer are derived from so few individuals that it is questionable whether it is a valid race with any considerable geographic range, or whether it is best to consider these specimens as intergrades between the typical and the coastal forms. The general dark blackish color in winter pelage is apparently much the same, and the tail is blackish above, broadly white below. Lydekker emphasizes the white tip of the tail, with only the basal two-thirds of the upper surface dark, but in specimens at hand this is not quite the case, for the dark color continues nearly to the tip of the tail.

Of cranial characters, the same author gives as diagnostic the relatively short nasals, and the smaller, deeper, and more regularly oval lachrymal pits. These characters seem, however, to be subject to much individual variation so that their value in discrimination of local races is yet to be tested. In general the skulls of the Ichang Tufted Deer are smaller than those of the upland typical race.

Measurements.—An adult female taken at Pudtze, Hupeh, was measured in the flesh by the collector, W. R. Zappey, as follows: total length, 1,700 mm.; tail, 70; hind foot, 440; height at shoulder, about 720.

Cranial measurements are given in the table under *E. c. cephalophus*.

Occurrence and Habits.—Tufted Deer from the vicinity of Ichang, Hupeh, and those from eastern Szechwan are regarded as belonging to this slightly smaller race, although when more specimens are available for comparison it is likely that its characters will be found difficult to define. At best it is an intermediate between the upland and lowland races, which are more definitely distinct. In addition to a fine female skin from Pudtze, western Hupeh, I have included under this name three specimens taken by the Central Asiatic Expeditions near Wanhhsien, Szechwan, Dr. Walter Granger, collector.

E. H. Wilson (1913, vol. 2, p. 168) writes that this deer is found sparingly throughout western Hupeh, between 3,000 and 8,000 feet altitude, in country similar to that in which Reeves's Muntjac occurs, although it does not descend to the river level. In early May, 1907, he saw two of them together in the mountains of Hsingshanhsien, and in later journeys in the same region often heard of its presence, although he saw none. The female from Pudtze taken in early April contained a single large fetus about the size of a house cat. They have the same hunched-up appearance in running as a muntjac and the Chinese name, "hei chi-tze," indicates Black Muntjac.

Specimens examined.—The following four or five:

Hupeh: Pudtze, 1 (M.C.Z.).

Szechwan: Wanhhsien, 3.

No locality, but probably Wanhhsien, 1.

477. *Elaphodus cephalophus michianus* (Swinhoe)

COASTAL TUFTED DEER

Lophotragus michianus Swinhoe, Proc. Zool. Soc. London, 1874, p. 452, pl. 59. Garrod, Proc. Zool. Soc. London, 1876, p. 757, pl. 76.

Elaphodus michianus Brooke, Proc. Zool. Soc. London, 1878, p. 900. Lydekker, Deer of All Lands, p. 214, pl. 17, fig. 1, 1898; Proc. Zool. Soc. London, 1904, vol. 2, p. 166, fig. (skull).

Elaphodus michianus fociensis Lydekker, Proc. Zool. Soc. London, 1904, vol. 2, p. 169. Fingling, Fukien.

Elaphodus cephalophus michianus Pocock, Proc. Zool. Soc. London, 1910, p. 956. Lydekker, Cat. Ungulate Mamm. Brit. Mus., vol. 4, p. 36, fig. 7 (skull), 1915. G. M. Allen, Amer. Mus. Novitates, no. 430, p. 10, 1930.

Elaphodus cephalophus fociensis Lydekker, Cat. Ungulate Mamm. Brit. Mus., vol. 4, p. 38, 1915.

Type specimen.—The type is a mounted skin of a female from near Ningpo, Chekiang, China, and now in the Zoological Museum at Berlin, Germany, whither it was evidently sent by Consul Robert Swinhoe about 1874 (see Garrod, 1876, p. 757).

Description.—This is a smaller and slightly paler race than that of the western Chinese highlands. The general coloring is more grayish black than chocolate brown, as in the latter, the hair about the head especially drabby, with a sprinkling of white tips instead of blackish brown. The amount of white on the tips of the ears, used as a diagnostic character by Lydekker, appears to be variable in different individuals, as often with white markings, but usually includes the hair of the inner surface, the edges and the tip, except a variable portion of the outer margin of the metectote, which is dark. Usually there is a narrow line of white hairs just above the hoof.

The chief distinction of this form, other than its slightly grayer color, lies in the smaller and more slender skull, with narrow, pinched-in nasals, giving the muzzle a more compressed appearance. The shape of the suborbital pit varies individually and cannot be relied upon too far in racial discrimination. It probably averages narrower in the shorter diameter and is oval instead of nearly circular.

Measurements.—External measurements are not available. Cranial dimensions are given in the table under the typical race. In an adult male topotype the upper canine measures 32.5 mm. on the chord from the tip to the posterior border of the alveolus. In females of the species the upper canine is about 11 mm. long, projecting nearly straight downward instead of curving.

Nomenclature.—Swinhoe, who described this deer in 1874, believed it represented a new genus, which he named *Lophotragus*, but Garrod (1876), who examined the type at Berlin and also the specimens of *Elaphodus* at the Paris Museum, pointed out that the two were congeneric, although he continued to treat them as distinct species. With further knowledge, it now seems evident that the coastal animal is but a subspecies of the Muping Tufted Deer. In 1904 Lydekker named a female from Fingling, Fukien, collected by C. B. Rickett, *E. michianus fociensis*, later referring it as a subspecies to *E. cephalophus*. The supposed differences were slightly larger size, a trifle darker color, and greater extent of white on the upper part of the ears. His single specimen, the type, is No. 98.3.7.18 in the collection of the British Museum. After examining three other specimens from the same province, however, I conclude that the characters are variable and hardly of racial value. I have therefore considered *E. m. fociensis* a synonym of *E. c. michianus*.

Occurrence and Habits.—The coastal race of tufted deer was first found

by Swinhoe near Ningpo, Chekiang, where it is apparently not rare, living in cane brake, for the British Museum Catalogue lists some ten specimens from that vicinity and another from one hundred miles southwest of that locality. The American Museum Asiatic Expeditions added new localities for it in Fukien, namely, northwestern Fukien near Chunganhhsien, and Yenping in mountainous country. Lydekker's type of *E. m. fociensis* was from Fingling in the same province. Farther south, Mell (1922) obtained specimens in northern Kwangtung, from Fungwahn, "Tea Mountain," and "Dragon's Head." One of these was driven into a rice field and captured alive. It lived in captivity for over a year in an enclosure, and eventually became quite fearless, was fond of salt and would lick people's hands. On another occasion, a female chased by Wild Dogs ran into a villager's house and was killed with a stick. This was on January 10, and it was found to contain a small fetus as large as one's fist. The animal weighed 39.4 pounds. Probably the range was formerly quite continuous from the Ningpo region to southern China.

In spite of the secretive habits of this little deer, it has on various occasions been exhibited alive in the London Zoological Gardens. Sclater (1876) gave a brief account of one sent by Swinhoe from Ningpo shortly after his discovery of it there, and the specimen is figured in Swinhoe's plate 59 (1874). A young male from an unknown locality was the second to be received alive at London in October, 1878. It had been caught in a trap and had sustained an injury to one fore foot. Another male purchased in August, 1880, was the fourth to be received by the Gardens. Styan (1886) has described the young from two procured for him in the summer of 1885 near Ningpo, and believed to be not more than two or three weeks old. They were said to be similar in color to the adult, with a pronounced frontal tuft, and on each side of the back a row of "not very distinctly marked white spots, and outside that again just the faintest suspicion of another row."

Specimens examined:—The five following:

Chekiang: Ningpo, 2 skulls (M.C.Z.).

Fukien: Chunganhhsien, 2; Yenping, 1.

Genus *Muntiacus* Rafinesque

MUNTJACS

Muntiacus Rafinesque, *Analyse de la Nature*, p. 56, 1815.

Cervulus Blainville, *Bull. Soc. Philom. Paris*, ser. 3, vol. 3, p. 74, 1816.

The muntjacs are small deer having the lateral metacarpals represented by the upper ends of these bones (plesiometacarpalian) instead of the distal ends. The males have the upper canines developed as short curved tusks, directed outwardly, while at the same time possessing simple antlers. These

are borne on long permanent bony cores or pedicels, covered by the skin of the head, and are continued as raised bony ridges converging anteriorly on the frontals. The antlers have a short basal tine directed inward, and a main beam which turns slightly inward at the tip. In older animals there is a well-developed burr, and the surface of the shaft is marked by rough longitudinal ridges. Even adult animals, however, may lack the basal snag. In females no antlers are developed, but the bony ridges are present on the frontals. A deep rounded pit for the reception of the large suborbital gland lies in front of the orbit and is of about equal diameter, and there is a pair of small glands on the frontal, on the inner side of the ridges in some species. Tarsal and metatarsal glands are, however, lacking. The lateral toes are extremely small or wanting altogether and lack the phalangeal bones. Ears relatively short, hardly more than half the length of the head. Nose with a large naked pad or rhinarium. Tail of medium length. The teeth are of the usual short-crowned type, three premolars and three molars in each series, giving the formula: $i.\frac{0}{3}$ $c.\frac{1}{1}$ $pm.\frac{3}{3}$ $m.\frac{3}{3}$ = 34. The lower canines are, as usual, incisiform.

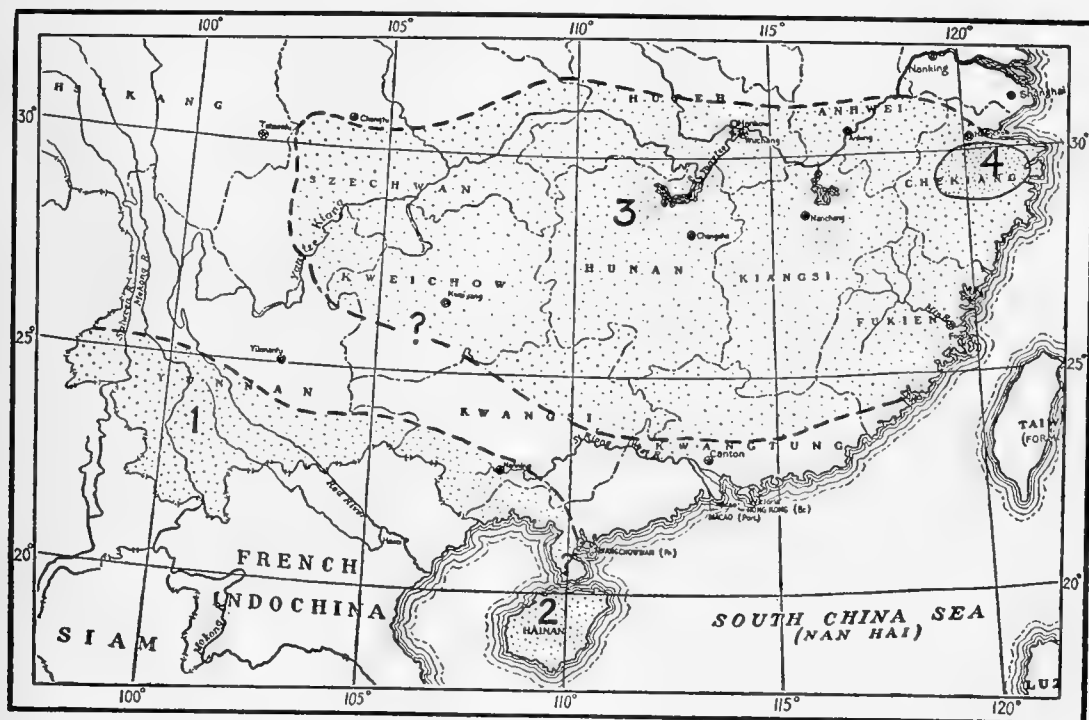


FIG. 65. Distribution Map.
Muntiacus

1. *M. muntjak vaginalis*
2. *M. muntjak nigripes*

3. *M. reevesi*
4. *M. crinifrons*

The type species is *Cervus* (= *Muntiacus*) *muntjak* Zimmermann of Java. Three species of muntjac occur in China: in the rare *M. crinifrons* the tail is

black above; in the others the coloring is somewhat alike, the tail chestnut, but one is considerably larger and more southern in its distribution, the other smaller and occurring only in south-central China. The Chinese muntjacs may be identified by the following key.

KEY TO THE CHINESE SPECIES OF *Muntiacus*

- A. General color, including top of tail, reddish or fulvous.
- a. Size larger, condylobasal length of skull 170 mm. or more; upper end of premaxillary abutting directly against the nasal bone.
 - a'. Legs clear ochraceous, seldom darkened by brownish. *Muntiacus muntjak vaginalis*
 - b'. Legs much darkened by blackish to blackish brown. *M. muntjak nigripes* (island of Hainan)
 - b. Size smaller, condylobasal length of skull less than 170 mm.; upper end of premaxillary separated from nasal by a projection of the maxillary *M. reevesi*
- B. General color, including top of tail, dark blackish. *M. crinifrons*

478. *Muntiacus muntjak vaginalis* (Boddaert)

LARGE INDIAN MUNTJAC

Cervus vaginalis Boddaert, *Elenchus Animalium*, vol. 1, p. 136, 1785.

Cervulus muntjac Anderson, *Anat. and Zool. Researches Western Yunnan*, p. 337, 1879.

Muntiacus vaginalis Wroughton, *Journ. Bombay Nat. Hist. Soc.*, vol. 21, p. 825, 1912.

Cervulus muntjac vaginalis Lydekker, *Rowland Ward's Records of Big Game*, ed. 7, p. 80, 1914.

Muntiacus muntjak vaginalis Lydekker, *Cat. Ungulate Mamm. Brit. Mus.*, vol. 4, p. 21, 1915.

Type specimen.—The name was based by Boddaert on the muntjac of Bengal, India, which is thus the type locality, but probably no specimen is in existence that could be regarded as the type.

Description.—An adult male in winter pelage (February) from Yunnan may be described as follows: forehead to muzzle dusky, a pale-brown shading to a blackish patch or stripe on the anterior base of the antler pedicel. Crown and the area between the pedicels clear bright ochraceous. Upper lip near the end of the muzzle very narrowly whitish. Dorsal side of the neck from the occiput to the fore shoulders ochraceous, slightly mixed with dark brownish or blackish hairs. Remainder of the back and sides, including the upper surface of the tail, bright orange rufous or chestnut. Legs ochraceous, slightly washed with brown. Backs of the ears dusky, thinly lined inside with white hairs, those at the edges longer. Sides of the face, neck and lower throat light ochraceous; chin and upper throat whitish. Belly clear bright ochraceous; a narrow white stripe at the axilla and a larger white area at the groin continued down the inner side of the hind leg nearly to the foot and dorsally to include the

inner side of the buttocks and the under side of the tail. A second specimen is similar but without a white line on the upper lip, the upper part of the muzzle slightly and upper part of forehead much more chestnut. Legs very little washed with brownish. The young have a pattern of spots and stripes of white.

The skull is of the usual peculiar triangular form, with the antler pedicels, however, more slender than in the typical race of Java, and the antlers themselves less heavy and ribbed. The skull is larger than that of the Chinese *M. reevesi* and may at once be distinguished not only by its greater size, but also by the fact that: (1) the suborbital gland occupies a depression taking in only the lower two-thirds of the lachrymal bone instead of nearly the entire bone, and (2) the ascending branch of the premaxillary abuts against the lateral border of the nasal instead of being separated from it by an intervening portion of the maxillary. The upper canines are relatively short, the length of the chord from tip to base about equaling the length of the three premolars, and are very narrow, strongly curved backward, with a sharp posterior edge. The pedicels of the antlers tend to be long, so that their length from back of orbit to base of antler equals or exceeds the distance from back of orbit to end of muzzle. They are thus relatively longer than in *M. reevesi*.

Measurements:—Unfortunately no external measurements of the body are available.

Cranial dimensions follow:

CRANIAL MEASUREMENTS OF *MUNTIACUS MUNTJAK*

No.	Con- dylo- basal length	Basal length	Pala- tal length	Orbit to tip of muzzle	Zygo- matic width	Mas- toid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Sex	Locality
<i>M. muntjak vaginalis</i>											
43052	190	179	123	108	81.0	58.0	59.0	57.5	66	♀	Yunnan
43053	193	178	124	110	92.0	61.5	67.0	69.0	76	♀	Yunnan
43056	196	184	127	112	97.0	61.0	62.0	62.5	71	♀	Yunnan
13682 MCZ	—	182	125	111	89.0	65.0	(63.0)	67.0	(75)	♂	Tongking
<i>M. muntjak nigripes</i>											
60027	170	159	104	94	81.0	60.0	56.0	56.0	62	♂	Hainan
60082	181	170	109	102	86.5	63.0	61.5	61.0	67	♂	Hainan
60023	176	166	113	97	79.0	51.0	59.0	63.0	(71)	♀	Hainan

Occurrence and Habits:—The Indian Muntjac with its long antler pedicels just reaches the southern borders of China in Yunnan, for its main distribution is more southern. In India it reaches Nepal and Sikkim, and ranges southward through Burma to the larger East Indian islands, Java, Sumatra and Borneo. Eastward it is found in the forest areas across Indo-China and into northern Tongking. Very little is recorded of its presence in Chinese terri-

tory, but as long ago as 1879, Anderson in the course of his Yunnan expeditions recorded having found it "not at all uncommon on the Kakhyen hills, where its call was nightly heard around our camp at Ponsee, at 3,500 feet above the sea. It is very abundant in the hill ranges to the north of Teng-yue-chow, and at certain seasons its flesh is largely brought to the market for food, and its skin is held in high esteem as a leather, soft as the finest chamois." Dr. R. C. Andrews, in traversing western Yunnan, found this muntjac in the southwestern part of the province, and secured specimens at Mucheng, Taipingpu and Tengyueh, as well as on the Burma border at Namting River. A young one from Peitai furnishes about the most northerly locality where it was detected.

Specimens examined:—The following seven, in addition to one from Tongking:

Yunnan: Mucheng, 1; Peitai, 1; Taipingpu, 1; Tengyueh, 2; Namting River, 1; no exact locality, 1.

479. *Muntiacus muntjak nigripes* G. M. Allen

BLACK-FOOTED MUNTJAC

Muntiacus muntjak nigripes G. M. Allen, Amer. Mus. Novitates, no. 430, p. 11, 1930.

Cervulus vaginalis Swinhoe, Proc. Zool. Soc. London, 1869, p. 652 (part).

Cervulus muntjak J. A. Allen, Bull. Amer. Mus. Nat. Hist., vol. 22, p. 468, 1906.

Muntiacus muntjak, subsp., Lydekker, Cat. Ungulate Mamm. Brit. Mus., vol. 4, p. 25, 1915.

Type specimen:—An adult male, skin and skull, No. 60082, American Museum of Natural History, from Nodoo, island of Hainan, China. Collected December 29, 1929, by Clifford H. Pope, Central Asiatic Expeditions.

Description:—A slightly smaller race than *M. m. vaginalis*, as represented by Yunnan specimens, and with blackish legs. Forehead in front of the eyes, and the muzzle dusky brown; sides of the face and the crown clear bright ochraceous; a broad black mark on the front of each antler pedicel. Ears ochraceous at the base, becoming dusky at the tips; their inner surface scantily clothed with white hairs. Chin and interramal area white to pale buffy. Dorsal area of the neck dark chestnut brown, shading to bright chestnut on the back and the upper surface of the tail, slightly paler (bright ochraceous) on sides of neck, throat and flanks. The neck, especially, and the body are minutely ticked with black on account of the black subterminal bands of many of the hairs. Fore shoulder and fore limb blackish brown, becoming clear brown on the foot; hind legs similarly blackish near the hock, paling to brown on the front of the foot; inner side of the legs ochraceous at the upper part. Axilla and groin white, the latter area continuing on the inner side of the leg to the heel, and dorsally to include the posterior edge of the buttocks and under side of the tail.

The very young fawns have a distinct spotted pattern. The forehead and muzzle are uniform dark brown, but between the ears this dark area narrows and is continued down the nape as a median narrow line of brown to the shoulders, where the coloring gradually merges with the mixed ochraceous and brown of the back. Sides of the face and of the occiput ochraceous. An indistinct narrow line of whitish with a buffy tint begins on each side of the median brown stripe of the nape just back of each ear and continues to the level of the fore shoulder, where it becomes more or less broken into streaks which may be traced as far as the base of the tail. A second line of indistinct spots begins on each side of the body back of the shoulder and is traceable to the hip. Two other rows of spots are dimly to be made out, lateral to those on the trunk, the upper one of which in its anterior half is a practically continuous stripe. On the upper part of the haunches these stripes are represented by somewhat larger spots. Sides of the neck and the belly pale ochraceous, lightened by the pale bases of the hairs. Axillæ white; inner side of hind leg nearly to the heel, and lower side of tail white. Center of the fore leg in front marked by a line of wood brown, and a similar but less-dark line on the front of the hind foot.

The skull in all its proportions is slightly smaller than that of *M. m. vaginalis*, with a shorter tooth row, and correspondingly smaller teeth. The antlers, too, are apparently less well developed, with a very small basal point showing as a mere projection; the pedicels of the antlers also are smaller.

Measurements:—No measurements of the exterior of fresh specimens are available.

For cranial measurements of the type and other specimens, see table under *M. m. vaginalis*.

Occurrence and Habits:—Swinhoe (1869), when he published his list of Hainan mammals, knew of the presence of a muntjac on the island, and rightly referred it to the larger Indian species, noting also that the fore leg is strongly tinged with black, whereas that of the latter is usually nearly uniform ochraceous. Lydekker (in his "Catalogue of the Ungulate Mammals in the British Museum," vol. 4, 1915) suspected that the island form was probably different, but did not venture to name it. Its smaller size and darker legs seem, however, to mark it as a subspecies distinct from the Indian animal. Apparently the large muntjac of the neighboring mainland of eastern Indo-China is much the same, and Osgood (1932) has included under *M. m. nigripes* two specimens from Hoi Xuan, coast of northern Annam.

Mr. Clifford H. Pope, who obtained a series of old and young from the vicinity of Nodda, Hainan, writes that the muntjac is common there and is hunted in the winter by the natives. Their method is to form a line of from

eight to thirty men along one side of a wild bush-covered section, while dogs are taken through to the opposite side, which drive the muntjacs to the waiting hunters. Every day through the winter lines of returning hunters may be seen. There is apparently a great deal of latitude in the breeding time. Thus a young one showing dim spots was secured on December 25, a larger one, with dull spots showing, on March 7, others in the first half of April, and finally a very small young one in spotted coat on June 8.

Specimens examined.—The following sixteen, of which nearly half are young or immature:

Hainan: Nodda, 13; Namfong, 2; locality ?, 1.

480. *Muntiacus reevesi* (Ogilby)

REEVES'S MUNTJAC

Cervus reevesi Ogilby, Proc. Zool. Soc. London, 1838, p. 105.

Prox reevesii Sundevall, Kongl. Vet.-Akad. Handlingar for 1844, Stockholm, p. 185, 1846.

Cervulus lacrimans Milne-Edwards, in David, Nouv. Arch. Mus. d'Hist. Nat. Paris, vol. 7, Bull., p. 93, footnote, 1871. Milne-Edwards, Recherches pour servir à l'Hist. Nat. des Mammifères, p. 348, pls. 63, 64, 1868-74. Western Szechwan.

Cervulus sclateri Swinhoe, Proc. Zool. Soc. London, 1872, p. 814. Near Ningpo, Chekiang.

Cervulus sinensis Hilzheimer, Zool. Anzeiger, vol. 29, p. 297, 1905; Abh. u. Ber. Mus. f. Natur- u. Heimatk., Magdeburg, vol. 1, p. 165, pl. 2, fig. 1, 1906. Probably Hwei Shan, Anhwei.

Cervulus reevesi pingshiangicus Hilzheimer, Abh. u. Ber. Mus. f. Natur- u. Heimatk., Magdeburg, vol. 1, p. 169, 1906. Pingshiang, Anhwei.

Cervulus bridgmani Lydekker, Abstract Proc. Zool. Soc. London, June 21, 1910, p. 38; Proc. Zool. Soc. London, for 1910, p. 989, 1911. Hwei Shan, Anhwei.

Muntiacus lacrymans G. M. Allen, Mem. Mus. Comp. Zool., vol. 40, p. 204, 1912. Lydekker, Cat. Ungulate Mamm. Brit. Mus., vol. 4, p. 25, 1915.

Muntiacus lacrymans lacrymans Lydekker, *ibid.*, p. 26.

Muntiacus lacrymans sclateri Lydekker, *ibid.*, p. 26.

Muntiacus lacrymans teesdalei Lydekker, *ibid.*, p. 27. Tatung, Yangtze valley.

Muntiacus reevesi Lydekker, *ibid.*, p. 27. G. M. Allen, Amer. Mus. Novitates, no. 430, p. 12, 1930.

Muntiacus reevesi reevesi Lydekker, Cat. Ungulate Mamm. Brit. Mus., vol. 4, p. 28, 1915.

Muntiacus reevesi pingshiangicus Lydekker, *ibid.*, p. 30.

Muntiacus sinensis Lydekker, *ibid.*, p. 31.

Muntiacus reevesii lacrymans A. B. Howell, Proc. U. S. Nat. Mus., vol. 75, art. 1, p. 75, 1929.

Muntiacus reevesii sclateri A. B. Howell, *ibid.*, p. 76.

Muntiacus reevesii reevesii (sic) Shih, Bull. Dept. Biol., Sun Yatsen Univ., Canton, no. 4, p. 9, 1930.

Type specimen.—The type is a skin and imperfect skull, No. 55.12.24.283, British Museum, from near Canton, Kwangtung, China. Collected by J. R. Reeves about 1838.

Description.—In summer, muzzle from the rhinarium back to the bases of the antlers, dull brown; a broad black line from the frontal gland to the antler along the front of the pedicel. Sides of the muzzle, face and upper neck, the area between the black facial stripes and back including the occiput, the area at the base of the ears and the outer sides of the ears, clear bright ochraceous; upper edges of ears dark seal brown, their inner edges with a thin

covering of longer white hairs. Remainder of the dorsal surfaces of neck and body darker, a nearly uniform ochraceous brown, due to a fine mixture of ochraceous and brown, the individual hairs being drab or whitish at the basal two-thirds, then with a narrow band of seal brown and a bright ochraceous tip. This coloring extends to the legs, but the ochraceous element becomes less on the lower front aspect of the limbs and may be then nearly clear dull brown, almost blackish near the hoofs. Fore chest of the same mixture, but slightly duller than on the sides. Upper throat and chin pure white, as well as a narrow axillary area. Lower chest and belly, inner side of the hind legs to the heel level, edge of the buttocks and under side of tail white. A narrow area fringing the buttocks as well as the upper side of the tail, nearly clear orange-ochraceous.

There is considerable individual variation in the intensity of the different shades of coloring. Thus the ochraceous of the body may be intensified to a dull chestnut, or the hairs of the flanks may lack the minute dark tip and be nearly clear ochraceous. More extensive dusky bases to the hairs of the back and longer black points tend to darken the general appearance, so that the entire sides of the body may be dull drab, the legs dark brown, and the cheeks darkened with brown. The throat instead of being white may be suffused with ochraceous buff. The dark nuchal line may be very faint or wanting, but usually extends half-way to the withers, and in females usually spreads out anteriorly to form a dark-brown patch covering the forehead, while in adult males the forehead becomes clearer and brighter ochraceous-rufous with age, with the black confined to the streak on the front of the antler pedicels. A rather remarkable change with increasing age in males is seen in the ears, which become more and more ochraceous on the backs until the entire back of the ear is of the same bright tint as the sides of the neck and occiput, while in females and younger males the ears are dark blackish brown externally. These changes seem to be the basis for the supposed subspecies *M. r. ping-shiangensis* and others.

Winter skins average somewhat darker than those taken in summer.

The skull is about a third smaller than that of *M. m. vaginalis*, and in addition to its much larger suborbital gland which occupies the pit formed by all but a narrow dorsal strip of the lachrymal bone, is at once distinguishable by the fact that the premaxillary does not reach the nasal but is separated by a narrow intervening tongue of the maxillary. The antlers have a very small basal point, often hardly more than a projection, or it may be wanting altogether. The tips of the main shafts usually turn inward and downward. Swinhoe believed that the antler pedicels become shorter with age, but although they undoubtedly increase in diameter and vertical thickness, the length seems to be, in part at least, an individual matter, varying in immature specimens of

comparable age, as well as in adults from the same locality showing corresponding conditions of tooth wear and cranial development.

The young show a spotted pattern much as described for *M. m. nigripes*, with a dull-chestnut ground color. It was at one time believed, however, that this stage was skipped, for it is evident only in very young animals.

Measurements.—The following fresh measurements were made by the collectors:

No.	Head and body	Tail	Hind foot	Ear	Sex	Locality
58368	790	120	210	85	Ad. ♂	Szechwan
11543 MCZ	873	120	223	—	♂	Hupeh

Standing height at the shoulder in No. 11543, M.C.Z., is recorded as 445 mm. Mell (1922) found the weight of an adult male from Kwangtung to be 15 kilograms.

Cranial measurements of a series of both sexes follow:

CRANIAL MEASUREMENTS OF *MUNTIACUS REEVESI*

No.	Condylor-basal length	Basal length	Palatal length	Orbit to tip of premaxillae	Zygomatic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
Adult Males										
41474	156	146	99	84.0	73.5	56.0	50.0	50.5	54.5	Fukien
43044	159	147	102	86.0	75.0	62.0	51.0	50.0	—	Fukien
45564	155	145	98	84.0	73.0	60.0	50.0	49.0	54.0	Fukien
45570	154	143	99	79.0	76.0	59.0	53.0	48.5	53.0	Fukien
47857	158	147	98	85.0	79.0	60.0	56.0	49.0	54.5	Fukien
59327	157	148	101	85.0	74.0	59.0	49.0	52.0	57.0	Fukien
84458	157	149	103	90.0	79.0	61.0	51.0	50.5	57.0	Fukien
45345	156	146	99	86.0	72.0	60.0	50.0	49.0	52.0	Chekiang
45341	153	141	95	80.0	71.0	59.0	49.0	48.0	52.5	Chekiang
56993	156	147	99	88.0	71.0	55.0	51.0	54.0	59.0	Hunan
11543 MCZ	159	148	100	88.0	76.0	60.0	53.0	48.0	54.5	Hupeh
16483 MCZ	164	154	105	89.0	76.0	60.0	53.0	51.0	55.0	Hupeh
58368	153	145	100	84.0	80.0	56.0	53.4	47.0	53.0	Szechwan
Adult Females										
56987	156	146	103	89.0	74.0	53.5	52.0	42.0	53.0	Fukien
56988	150	139	94	78.5	65.5	55.0	50.0	43.5	51.0	Fukien
56989	155	145	103	84.0	68.0	52.5	49.0	50.0	54.0	Fukien
84454	162	151	105	88.0	65.5	53.0	47.0	53.0	58.0	Fukien
59326	147	137	96	80.0	67.0	50.0	49.0	50.0	57.0	Fukien
60128	153	143	99	84.0	69.0	53.0	50.5	49.0	55.0	Fukien
45342	152	142	97	83.0	66.5	51.0	50.5	50.0	57.0	Chekiang
56992	146	136	94	80.0	63.0	49.0	47.5	52.0	57.0	Hunan
16484 MCZ	160	150	102	87.0	72.0	57.5	54.0	52.0	59.0	Hupeh
16494 MCZ	157	—	104	87.0	69.0	54.0	52.0	51.0	54.5	Hupeh

PLATE XII



Head of a Large Indian Muntjac (*Muntiacus muntjak vaginalis*). Killed by Dr. Roy C. Andrews in southwestern Yunnan



Head of a Reeves's Muntjac (*Muntiacus reevesi*). Killed near Wanhsien, eastern Szechwan

Nomenclature.—After a comparison of a large series of skins and skulls of this small deer, I cannot see that reliable characters exist for the recognition of any of the various names that have been applied as specific or subspecific designations, beyond the original one. Lydekker (1915), in his list of ungulate mammals in the British Museum, made no fewer than three distinct species, and three subspecies besides, of the small Chinese Muntjac, regarding *M. lacrymans* as separate from *M. reevesi* and *M. sinensis* on account chiefly of the all-yellow backs of the ears. This, however, turns out to be a character of adult males, while immature males and the females have the ears more or less blackish. The two latter "species" are in his key said to differ in color, whether redder or browner, and in the size of the lachrymal pits as compared with the orbits. The differences of color, however, are in part seasonal and in part individual, while the size of the pits varies in different skulls and is hardly reliable as the sole specific difference. As to *M. sinensis*, even Matschie (1908), who examined the type, concluded that it was identical with *M. lacrymans* and that Hilzheimer's *Cervulus reevesi pingshiangicus* is not really different from either. Lydekker makes *sclateri* of the lower Yangtze basin a subspecies of *M. lacrymans*, with the guarded phrase that it is "apparently distinguished . . . by its smaller size and by the more strongly marked contrast between the yellow of the forehead and the rufous or olive of the neck," distinctions, however, due in part to age. Lydekker's *M. lacrymans teesdalei* from Tatung, Yangtze valley, comes from within the area he assigns to *M. l. sclateri*, and although said to be small, has a basal length of skull of $5\frac{7}{8}$ inches (150 mm.), which is not unusually small. Lydekker himself, in the later review, relegates his *Cervulus bridgmani* from Anhwei to the synonymy of *Muntiacus sinensis*. While it is quite possible that slight average characters may be found which will distinguish the northern individuals from those of the extreme southern part of the range of *reevesi*, yet with the considerable amount of material I have examined, I would at present recognize only the single species. Howell mentions that his two specimens from Kiangsu have the outline of the skull from the premaxillæ to the zygomatic arches almost straight instead of much curved, and he would call these *M. r. sclateri*. This muntjac is represented on the island of Formosa by what is said to be a much richer- and darker-colored race. This was named *Cervulus micrurus* by Sclater, its main distinction being its short tail as compared with the mainland animal. This, however, was later found to be due to the fact that the tail had been docked!

Occurrence and Habits.—If one regards the lesser muntjac of China as representing but a single species, it is found from the province of Kwangtung north to Anhwei and westward to the lower country of Szechwan. It is abundant in the wooded parts of Fukien and in the lower Yangtze valley. To the

west, W. R. Zappey secured it near Ichang, while farther up the river A. B. Howell (1929) records specimens in the U. S. National Museum from Suifu, Omei Shan and Wa Shan in southeastern Szechwan, these last from near the supposed type locality of Milne-Edwards's *Cervulus lacrimans*. How high up in this mountain country it goes is not clear, but probably, like other mammals of these areas, it attains to a considerable altitude where conditions are favorable. E. H. Wilson (1913, vol. 2, p. 166) writes that in Szechwan they are scattered through the hilly country over the province, but probably this applies to the eastern part; he adds that they are "quite common in regions bordering the western limit of the Red Basin up to 7000 feet elevation." About Ichang it was found locally common from the river level up to 5,000 feet altitude at the head of the Ichang Gorge. Milne-Edwards wrote of his *Cervulus lacrimans* that it was rare in eastern Tibet, meaning the country about Muping, Szechwan, and that it preferred a more equable climate. There is no definite record of this muntjac for Yunnan, although Pousargues (1896a, p. 4) adds "*Cervulus lacrymans*" to the known fauna of that province on the basis of a specimen brought back by Prince Henri d'Orléans, without definite locality. It seems likely, however, that this may have been *M. muntiacus vaginalis*. Reeves's Muntjac is to be looked for in Kweichow, which is still little known. In Kwangtung, according to Mell (1922), it is frequent in both the northern and the southern parts, and Shih (1930) found it in the Yao Shan of that province and Kwangsi.

In its habits Reeves's Muntjac is solitary, though often a number of individuals are to be found within a circumscribed area. In the country about Ichang, Wilson writes that it frequents brush-clad rocky places and thin woods of pine and oak with undergrowth. By day it hides away in narrow ravines and gullies with brush-clad sides, preferring always the steeper types of country. If started, they usually have well-defined areas to which they retreat, and though not fast can slip through cover at a rapid pace. When running, the head and neck are carried low and the gait is "rather ungainly." Mell (1922), writing of this species in Kwangtung, mentions its secretive habits and says that the breeding season is late January and February and that the young are born in early June. He examined a gravid female on May 24. The young, he says, are in the spotted coat until the following year. The stomach of a male that he collected contained leaves of *Myrica rubra* and shoots of *Cunninghamia*. Sclater (1875) gives an account of a female from Ningpo, sent to the Zoological Gardens at London, that gave birth to a young one July 13, 1874, and a second on the following May 27. His colored plate figures the young in its spotted coat at the age of sixteen days.

In Fukien Mr. Clifford H. Pope found this muntjac abundant on the open hills and mountains as well as in the forested country about Futsing. In the

open grassy hills along the coast it may be roused from its hiding places by day in briar patches, behind deserted houses, or near old grass-grown graves as well as in the more densely covered ravines and mountain sides farther inland. Near Yenping it was common in open bamboo groves as well as in the higher and wilder mountains about Kuatun, although seeming to avoid the high forest. The native hunter, Da Da, whom he employed, was extremely skilful in still-hunting the muntjac. His success was partly due to his taking advantage of the animal's dislike of drenched foliage by going out immediately after a heavy shower or during a break in a rainy spell, and by quietly working his way to the edge of a clearing or to some place where a dense cover thinned out, coming upon the muntjac, which seemed to be trying to avoid the wet foliage. The Chinese also hunt these animals with packs of dogs which start the quarry while the hunter, stationing himself at a point where it is expected to pass, endeavors to shoot it as it rushes by. Wilson regards muntjac hunting as good sport and the meat as "most excellent eating." The Chinese name of the muntjac is "chi-tze."

Specimens examined:—The following seventy-three:

Chekiang: Tunglu, 5.

Kiangsu: Chinkiang, 1.

Fukien: Chungansien, 6; Futsing, 24; Foochow, 1; Yenping, 18; Yuki, 1.

Hupei: Ichang and vicinity, 7 (M.C.Z.); Changyanghsien, 1 (M.C.Z.).

Hunan: Yochow, 4.

Szechwan: Wanhsien, 3; Hupei border, 2.

481. *Muntiacus crinifrons* (Sclater)

BLACK MUNTJAC

Cervulus crinifrons Sclater, Proc. Zool. Soc. London, 1885, p. 1, pl. 1.

Muntiacus crinifrons Lydekker, Cat. Ungulate Mamm. Brit. Mus., vol. 4, p. 33, 1915. G. M. Allen, Amer. Mus. Novitates, no. 430, p. 15, 1930.

Type specimen:—A mounted skin and a skeleton in the British Museum, No. 91.3.4.1, from near Ningpo, Chekiang, China. Collected by A. Michie in 1885, and sent alive to the Zoological Society of London.

Description:—General coloration dark blackish brown with back of the tail also blackish instead of reddish. Muzzle from between the eyes to the nasal pad light brown, minutely ticked with ochraceous, the sides of the muzzle with more of the ochraceous ticking; forehead, including the well-developed tuft of longer hairs, the occiput, sides of face and backs of ears, ochraceous. Interramal area dull white. Neck all around and the fore shoulder dark brown, minutely ticked with ochraceous; the rest of the back similar but the ochraceous ticking less marked, giving a darker, blackish-brown effect. Tail blackish above, slightly mixed with ochraceous; white underneath. Flanks,

belly and legs dark blackish brown with white above the bases of the hoofs and a few white hairs down the front of the lower fore leg. Inguinal area white with a narrow ochraceous border; buttocks edged with white.

Coloration of the young unknown.

Frontal glands are present in the usual situation in the single specimen examined; Lydekker (1915) asserts, however, that they are wanting in this species.

The skull is about the size of that of *M. muntjak vaginalis* and the palate is similarly prolonged behind the tooth rows as a short tube, at the front end of which the vomer reaches the posterior edge of the palate. The nasals are expanded behind as in that species. The canines in the male have rather short roots extending about half-way into the height of the premaxillary.

Measurements:—This is said to be the largest known species of muntjac, standing 24.5 inches in height at the shoulder. Styan (1886) gives the dimensions of a female from Ningpo, as taken from the dry specimen, as follows: head and body, 46 inches; tail, 6.5 inches; hind foot, 11 inches (280 mm.); ear, 4 inches (105 mm.).

The skull of the male obtained by Dr. R. C. Andrews at Tunglu, Chekiang, is broken so that total length and other length measurements are not obtainable. Other measurements, however, are as follows:

Zygomatic width.....	88.0 mm.
Mastoid width.....	62.0
Diameter of orbit.....	35.0
Diameter of facial gland.....	30.0
Length of antler pedicel.....	48.0
Length of antler.....	65.0
Width across molars.....	63.0
Upper cheek teeth.....	60.5
Lower cheek teeth.....	68.0

Sclater wrote that the original specimen had a tail of 9 inches in length (probably, however, this included the terminal hairs).

Occurrence and Habits:—This is one of the rarest and least known of Chinese deer, of which only three specimens appear to have been recorded. The first of these, afterward made the type of the species, was sent by A. Michie of Ningpo, Chekiang, to the Zoological Society of London, through Henry E. Dresser in 1885. In 1891 the specimen was acquired by the British Museum, and is listed by Lydekker (1915) as the only example in that institution. An excellent colored plate and a figure showing the tuft of long hair on the forehead, nearly hiding the very short antlers, were published by Sclater with his description. In the year 1886 a female specimen of this deer was secured at

Ningpo by F. W. Styan, who gave a careful description of the color, and states that it had small bony pedicels. This made the second known specimen, but its eventual disposition is unrecorded. It was apparently quite unknown to the Chinese hunters, and it was only through persistence in sending his collector in search of it that Styan succeeded eventually in obtaining this one. The specimen secured by Dr. R. C. Andrews in February, 1920, was taken at Tunglu, Chekiang, and is interesting as not only adding another locality, even though not far from Ningpo, but also in furnishing evidence that the species is still in existence. Its antler measures 65 mm. in length and is thus nearly half again as long as that of the original male, which for many years has necessarily stood as the "world's record" head in Rowland Ward's lists.

The possible relationship of this deer with *M. feæ*, a similarly colored species of Tenasserim, has been suggested, and very likely the two are closely connected. The Indian species, however, is apparently smaller, without the crest of stiff hairs on the forehead.

Except for the bare facts furnished by these three examples, nothing is known of this muntjac. Possibly its habits are so secretive as to give it comparative safety, or perhaps it really is represented by a handful of individuals in the section of the Chinese coast at the mouth of the Yangtze, and may now be on the verge of extinction.

Specimens examined.—One, a male, from Tunglu, Chekiang.

Genus *Capreolus* Gray

ROE DEER

Capreolus Gray, London Medical Repository, vol. 15, p. 307, 1821. Miller, Cat. Mamm. Western Europe, p. 972, 1912.

Cervus Linnaeus, Syst. Nat., ed. 10, vol. 1, p. 68, 1758 (in part).

Caprea Ogilby, Proc. Zool. Soc. London, for 1836, p. 135, 1837.

The Roe are small, delicately built deer, standing about 2.5 feet high at the shoulder, and agree with *Hydropotes*, *Alces*, and the American *Odocoileus* in retaining the *distal* ends of the lateral metacarpals, but the significance of this character loses some of its importance in view of the fact that unlike the last, the vomer shows no tendency to extend backward dividing the posterior nares; furthermore, these genera are widely different in other ways. Externally, the Roe Deer in winter coat much resembles *Hydropotes*, but has a contrasted white rump-patch, a conspicuous metatarsal gland high up and marked by a tuft of stiffer hairs; the tail is even more reduced, being a mere stump, and the canines are wanting in the upper jaw except in abnormal cases. Foot glands open on the anterior side of the hind pasterns, and there is a sub-orbital gland of medium size, which makes a shallow pit in the skull before the eye. The rhinarium is smaller than in *Hydropotes*, with its upper edge

nearly straight across. The antlers are normally present in the male only, and are of characteristic and primitive form, with short, stout pedicels, from which the main beam ascends some three or four inches before dividing into an anterior and a posterior branch, the latter forking once more, making three points in all, of which the posteriormost hooks strongly inward. The basal part of the antler in older animals is much roughened ("pearly"). The lower incisors are as usual in the subfamily, the central pair largest and with the outer anterior corner slightly angular. The upper molars show practically no trace of the small accessory column of enamel in the valley between the two inner cusps, but slight suggestion of it may appear in the two anterior molars of the lower jaw. The young have the coat spotted and striped with white.

The range of the Roe is continuous from the British Isles and the Mediterranean coast eastward north of the Himalayas to the Pacific coast of north temperate China and Korea, as far north as northern Mongolia. According to Lydekker, it does not reach the mouth of the Amur River.

This author recognizes three "species"—*C. capreolus* of Europe and western Asia (the genotype); *C. pygargus* from western Siberia to the Altai region; and *C. bedfordi* of China and Korea. In a later review of the subject, Flerov (1928) follows the same course, but in studying the specimens brought back by the American Museum Asiatic Expeditions it seemed to me that the supposed differences separating these deer are, after all, of a quantitative rather than a qualitative nature, and I proposed to regard the eastern forms as subspecies of the European (G. M. Allen, 1930b). Still more recently Barclay (1933) independently comes to the same conclusion, and shows that "the roe of Central and Eastern Asia . . . more closely resemble the roe of Sweden (the type-locality of *C. capreolus*) than do the roe of Scotland, Spain, France, and Armenia" and that "there is but one species of roe-deer." While the differences between the Chinese and Mongolian animal and that of northern Europe are probably small, in view of the lack of topotypes of *C. capreolus* for comparison, I am for the present assuming that the former is racially different.

482. *Capreolus capreolus bedfordi* Thomas

DUKE OF BEDFORD'S ROE

Capreolus bedfordi Thomas, Abstract Proc. Zool. Soc. London, June 23, 1908, p. 32; Proc. Zool. Soc. London, 1908, p. 645, pl. 32.

?*Cervus pygargus mantchuricus* Noack, Humboldt, vol. 8, p. 9, fig. 12, 1889 (not *Cervus mantchuricus* Swinhoe, 1864).

Capreolus caprea Buechner, Bull. Acad. Imp. Sci. St. Pétersbourg, vol. 34 (new ser., vol. 2), p. 115 (Mélanges Biol., vol. 13, p. 161), 1892.

Capreolus capraea var. *pygargus* Pousargues, Mém. Soc. Zool. de France, vol. 11, p. 220, 1898.

Capreolus melanotis Miller, Proc. Biol. Soc. Washington, vol. 24, p. 231, 1911. Kansu.

Capreolus bedfordi bedfordi Lydekker, Cat. Ungulate Mamm. Brit. Mus., vol. 4, p. 225, 1915.

Capreolus bedfordi melanotis Lydekker, loc. cit.

Type specimen.—An adult female, skin and skull, No. 8.8.7.99, British Museum, in winter coat, from Chiaocheng Shan, one hundred miles northwest of Taiyuanfu, Shansi, China. Collected November, 1907, by Malcolm P. Anderson.

Description.—In winter the coat is a nearly uniform mixed buffy and dark brown from the occiput to the white rump patch, and forward on the middle of the forehead to the muzzle. The sides of the face, base of the ears, the chest, and the legs are clearer, bright tawny. Lower part of chest with the hairs brownish at base and pale buffy in the terminal third; inguinal region with the long hairs whitish at base, becoming pinkish buff terminally. A conspicuous patch of pure white centers about the tail. Insides of the ears whitish. In a series from one region there is considerable individual variation in the tints of this coloring. On the sides and flanks the buffy tint may be intensified to rich ochraceous. The throat is usually more or less frosted with white, and in occasional specimens there are larger blotches of white. The absence of black marking on the upper lip and at the angle of the lower jaw, given as a distinguishing character of this race, is largely a matter of individual variation. Thus the white spot at each side of the muzzle may be absent, or small, or again extensive, forming a white border to the fore part of the upper lip. The dark mark directly behind it may also be obsolete, or in other individuals from the same locality it may form a prominent spot or mustachial mark, or even extend across the muzzle as a dark-brown band just back of the naked nose-pad. Similarly the dark mark at the angle of the jaw may be absent or more or less extensive. Obviously little reliance can be placed on these markings as racial characters. The chin is usually white, but in some individuals the whole interramal area is white.

The red summer pelage is very different from the buffy-gray one of winter. A specimen from near Taiyuanfu is clear bright ochraceous-rufous from muzzle to tail, including the legs, paling to buffy on the chest, and becoming rather abruptly clear white on the lower side from brisket to the inguinal region and the inside of the hind legs. The inside of the ears is also white, but the backs of the ears in specimens from the same locality are either a more or less even mixture of black and buff with the tips edged with black, or nearly the entire central area may be black. This change may possibly be correlated with age.

In the fawns there is some variation in the tint of the reddish coat, and there are on each side of the body three lengthwise rows of white spots with a few irregular spots between the two upper rows.

Adults from near Urga in late August are already developing the winter pelage, which in two shows in little patches on the neck and fore shoulders, while a third at about the same date is much farther advanced, with only a

little of the summer hair remaining on the rump region and the withers, while the white pygal patch is beginning to show also. Others taken at the same period are still in the red summer coat. The winter coat is carried till May.

A series of skulls shows much individual variation in the shape of the bones. Thus the nasals may be either rather narrow throughout their length, or expanded posteriorly, in one or two cases to an unusual degree; their ends may be deeply or shallowly emarginate. The premaxillæ are usually in close contact at their proximal ends with the tips of the nasals, but occasionally they only touch, or in others the two may be actually separated by a narrow forward prolongation of the maxillary. The location of the suborbital gland is marked by a shallow excavation with a wide opening, partly filled in by bony sheets, separating the lachrymal from the posterior border of the nasal. The molars lack the small accessory column of enamel at the mouth of the valley between the two cross-ridges. The antler pedicels are short and stouter in old animals, projecting backward at an angle from the upper posterior corner of the orbit, slightly back from its edge. In the female, when adult, the same structure is represented by a thickened ridge terminating at the outer posterior corner of the frontal. A slightly raised crest marks the center of the frontal area. Contrary to Thomas's statement, the crowns of the cheek teeth are no more hypsodont than those of western Roe, as was pointed out by Jacobi (1922).

Measurements:—Few external measurements of Chinese Roes are at hand. The only ones I have come upon are those recorded by Wallace (1913, p. 292), here converted into millimeters, as follows:

Length of body	Tail	Ear	Height at shoulder	Weight	Sex	Locality
1035 (straight line)	—	—	710	54.5 lbs.	♂	Kansu
1070 (straight line)	—	128	775	67.0 lbs.	♂	Kansu
1060 (on curve)	40	140	643	46.5 lbs.	♀	Shensi

Sowerby (1918, p. 50) mentions the weights of two males killed by him in Shansi as 60 and 65 pounds.

CRANIAL MEASUREMENTS OF *CAPREOLUS*

No.	Condylor- basal length	Basal length	Pala- tal length	Orbit to rostrum	Zygo- matic width	Mas- toid width	Width outside molars	Upper cheek teeth	Lower cheek teeth	Locality
Adult males										
46417	221	206	125	120	98.0	68.0	68.0	68.0	72.5	Mongolia
46420	210	195	120	111	108.0	69.0	71.0	65.0	70.0	Mongolia
57100	205	198	124	111	96.0	65.0	69.0	66.5	75.0	Hopei
45486	207	193	124	115	95.0	69.0	65.0	68.5	74.0	Shansi
45474	200	188	117	110	98.0	64.0	68.0	64.0	75.0	Shansi

CRANIAL MEASUREMENTS OF *CAPREOLUS* (Cont'd)

No.	Condylor-basal length	Basal length	Palatal length	Orbit to rostrum	Zygomatic width	Mastoid width	Width outside molars	Upper cheek teeth	Lower cheek teeth	Locality
Adult females										
46421	213	199	126	107	100.5	68.0	71.5	68.0	73.5	Mongolia
46419	207	192	125	110	90.5	64.5	65.0	63.0	67.0	Mongolia
57021	193	179	117	102	92.0	62.0	66.0	60.5	68.0	Hopei
57082	200	187	118	100	94.0	60.0	69.0	66.0	72.0	Hopei
57085	201	179	122	110	92.5	63.5	63.5	63.5	70.0	Hopei
57087	203	191	120	111	91.0	58.5	66.0	62.5	69.0	Hopei
57025	198	186	125	109	91.0	63.0	65.0	64.0	67.0	Hopei
57089	204	192	123	111	97.0	61.0	69.0	65.0	72.0	Hopei
57096	203	193	127	115	88.0	62.0	71.0	68.0	73.0	Hopei
57099	206	194	122	117	94.0	64.0	69.0	68.0	63.0	Hopei
45475	200	185	120	110	88.0	59.0	67.0	69.0	75.0	Shansi
45477	198	184	117	104	90.0	59.0	68.0	61.5	69.5	Shansi
45486	202	188	123	111	90.0	60.0	68.0	68.0	73.0	Shansi

The antlers of the Chinese and Mongolian Roe Deer average smaller than the larger ones of the Tien Shan and Altai race representing *C. pygargus*. "Rowland Ward's Records of Big Game" lists nothing over $13\frac{3}{8}$ inches (on outside curve) for the former, this record being for a Mongolian head, while the next largest is $12\frac{3}{4}$ inches for one from Laotsatzu, Hopei, with 12 inches for one from Kansu; Sowerby (1914, p. 10) mentions measuring a northern Shansi antler of 17.5 inches. For the Tien Shan race, many heads are listed between $14\frac{1}{2}$ and $17\frac{3}{4}$ inches.

Nomenclature.—There can be no doubt that the eastern forms of Roe Deer are merely subspecies of the western *C. capreolus*, for when a considerable series is examined, it is found to vary greatly in the details of coloration, as I have shown, so that it becomes difficult to find characters of really diagnostic value in separating subspecies. The oldest name applied to an eastern animal seems to be Noack's *Cervus pygargus mantschuricus*, but this is preoccupied by *Cervus mantchuricus* of Swinhoe for another species, as indicated by Thomas. The latter, in describing *Capreolus bedfordi* based on a female from Shansi, gave only the most brief diagnosis, and apparently made no comparisons with typical *C. capreolus*, nor has it been possible to examine series of the large race, *C. capreolus pygargus*, to determine whether or not there are any constant characters other than that of size to separate the subspecies. The name *Capreolus melanotis* was given in 1911 to a Roe from Kansu in the belief that the black ears were distinctive, but this proves to be a very variable character, and there is no doubt that the animal is identical with *C. bedfordi*, a conclusion already expressed by Jacobi (1922) who also failed to find that the teeth of

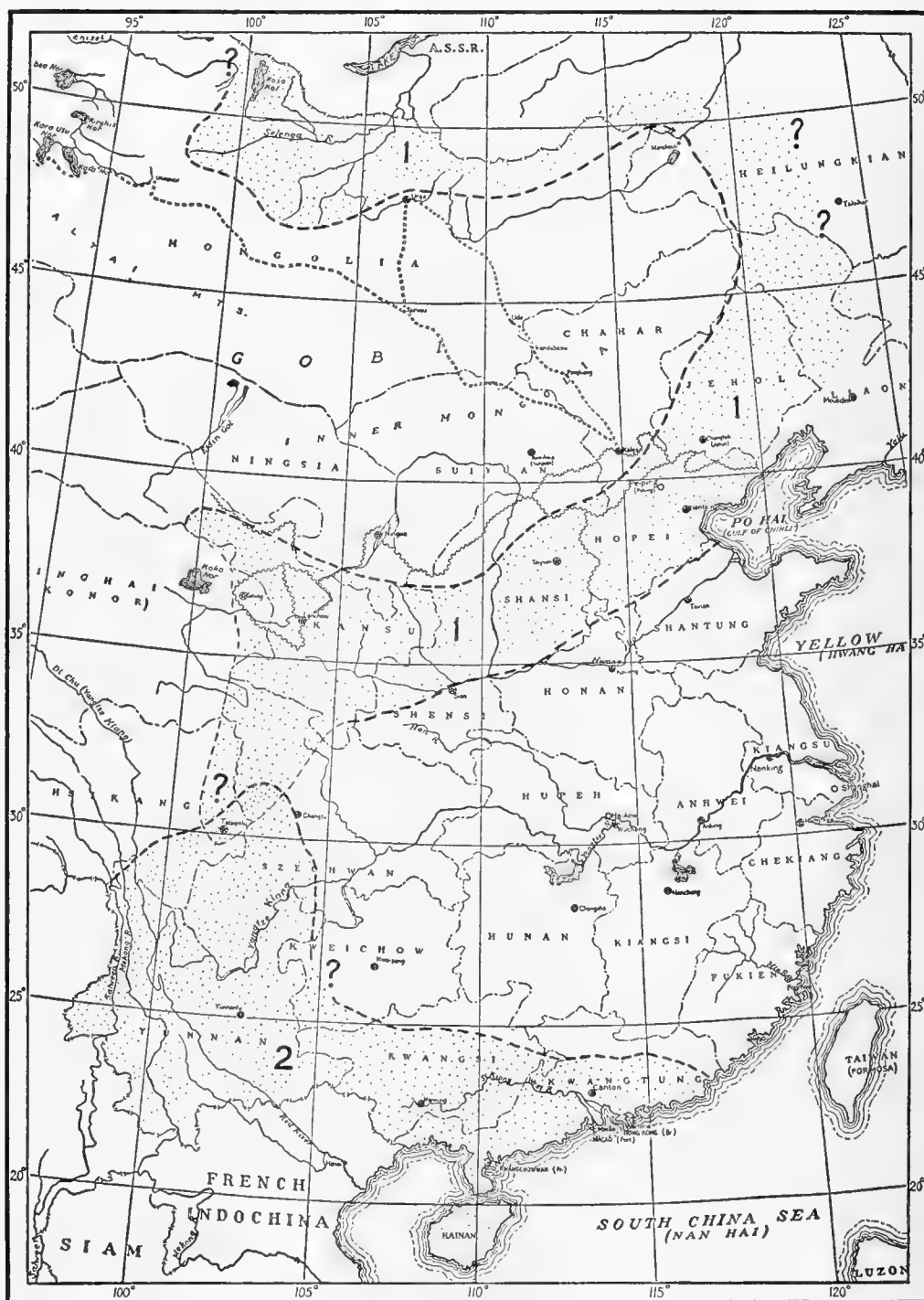


FIG. 66. Distribution Map.

*Capreolus*1. *C. capreolus bedfordi**Rusa*2. *R. unicolor dejeani*

the latter are more hypsodont than in typical *C. capreolus* as Thomas had supposed.

Occurrence and Habits:—Roe Deer, says Sowerby, occur commonly in China in almost any situation where there is a reasonable amount of cover and a small human population, for they are much hunted for their antlers when these are in the velvet. In the northern part of Mongolia where the forest edge comes down to the outer borders of the Gobi, Dr. Roy C. Andrews found them in some numbers as near Urga as fifteen, forty-five and sixty miles to the northeast of that city. Farther westward, he writes that they were abundant in the patches of forest about Sainnoin Khan (8,000 feet), but as they were shedding badly, he was unable to preserve specimens. None was heard of on Baga Bogdo or on Artsa Bogdo, and "indeed, none should be expected because neither of these mountains is forested even to a very limited extent." Northward of the northern Mongolian border, Radde (1862) traced them in the forested area in greater or less abundance from the Khingan Range and the Onon valley to the Syansk Mountains, on both north and south slopes of which they are common. He mentions their herding together in small companies in the valleys in winter, and notes that they avoid thick forest, preferring the lightly wooded valleys and lower slopes of the mountains. In the summer, however, they seek even the subalpine levels and delight in poplar thickets and growths of pine and fir, where they hide and where the does bring forth their young.

To the eastward of the Gobi, its range continues into parts of Hopei, where suitable conditions occur, as in the wild country of Laotsatzu north of Peiping, where Dr. Andrews obtained a series. Rhoads (1898) records it from the Imperial Hunting Park near Peiping. No doubt over-hunting has greatly reduced its numbers and deforestation has circumscribed its range in this area. To the south of the Gobi it is found on the Mongolian plateau at Dolon Nor (Sowerby, 1918, p. 158) and again over northern Shansi and Shensi to Kansu. In the western highlands it is found about Sungpan, northern Szechwan, for Jacobi records a skull from there, and Mr. Brooke Dolan in 1931 and in 1934-36 obtained it in that vicinity and learned of its presence between Tatsienlu and Dawo. Still farther south it probably reaches its southern limit in the vicinity of Tatsienlu, where, according to Pousargues (1898b, p. 220), it has several times been taken by the French missionaries who have sent the specimens to the Paris Museum. It also occurs to the northeast of the Sungpan district as far at least as the Nan Shan. Buechner (1892) reported it from the woodless regions of the hills of Choih sien, and Thomas (1911d) refers to this race a series of seven taken sixty miles southeast of Minchow, Kansu. Its southeastern limit in central China is perhaps repre-

sented by specimens recorded by J. A. Allen (1909a, p. 426) from Taipai Shan in extreme southern Shensi, an adult female and two fawns which still retained the spotted coat in late July and early August.

It is equally at home in the low loess hills of northern Shensi and eastern Kansu or in high rocky mountains elsewhere, wherever there is slight cover, and about the edges of forests. Rarely seen solitarily, it is usually in small groups of from two to five and has a way of advertising its presence by giving utterance when alarmed to a characteristic "bark." Sowerby (1914) has given an interesting account of the haunts and habits of this deer. It is extremely shy and possesses excellent powers of smell, hearing and eyesight, combined with speed. Its yellowish-brown coat of winter harmonizes well with the leafless bushes and withered grass, while in summer its bright rufous coloring "so exactly resembles the moistened patches of bare loess, that the hunter often fails to detect his quarry, though it be in full view." Its curiosity, however, often proves its undoing, for it will frequently stop to look for the cause of alarm instead of seeking safety and may even be decoyed by whistling with a grass blade held between the thumbs in imitation of the bleat of a young fawn, an unsportsmanlike trick practised by the Mongols. In early morning and evening it leaves the shelter of the forest in little bands of five or six, and seeks the open grassy spots, where it may graze on the luxuriant grass (Sowerby). It is sometimes possible to drive a piece of wooded cover.

The antlers are cast in November and December, and the new set begins to grow in February. By the last of May the antlers are burnished, and the rutting season commences in August. Two young are frequently born (Sowerby). A new species of flea, *Vermipsylla dorcadia*, was collected by Sowerby from the nostrils and skin of a Roe killed at Yenanku, Shensi, and described by Rothschild.

Specimens examined:—The following eighty, in addition to several from Korea:

Mongolia:

Fifteen miles northeast of Urga, 2; forty-five miles northeast of Urga, 5; sixty miles northeast of Urga, 10.

China:

Hopei: Laotsatzu, 19.

Shansi: Kweihwacheng, 13; Heshuin, 3; forty-three miles east of Paotowchen, 1; forty-five to sixty miles southwest of Taiyuanfu, 11 (M.C.Z.); Yirgo, twenty miles northwest of Kweihwacheng, 3 (M.C.Z.).

Szechwan: near Sungpan, 2 (M.C.Z.).

No exact locality, 11.

Genus **Rusa** Hamilton Smith**SAMBAR**

Rusa Hamilton Smith, in Griffith, *Animal Kingdom* by Cuvier, vol. 4, p. 108, 1827. Lydekker, *Deer of All Lands*, p. 141, 1898; *Cat. Ungulate Mamm. Brit. Mus.*, vol. 4, p. 60, 1915 (as a subgenus).

Hippelaphus Sundevall, *Kongl. Vet.-Akad. Handlingar* for 1844, Stockholm, p. 177, 1846.

Ussa Heude, *Mém. concern. l'Hist. Nat. de l'Emp. Chin.*, vol. 2, pt. 1, p. 20, 1888.

Sambar Heude, *ibid.*, pp. 20, 41.

The rusine group differs in so many ways from the northern typical cervine species of deer that it quite merits generic separation, although in most works it is considered as at most a subgenus of *Cervus*. Not only has it a different range, being characteristic of the tropical and subtropical oriental region instead of holarctic in distribution, but its type of coloring, uniformly dark without light ticking, and its antlers are different, while the tail instead of being a mere stump is well developed. The antlers are borne on short pedicels, in the male sex only, and consist of an anterior more or less straight brow tine, that comes off at a sharp angle to the main or posterior beam, which forks but once, the hind branch of the fork usually the longer in the continental form. There are thus but three tines to each antler, and the surface of the beam is much roughened and corrugated. The rough hair of the neck forms a sort of mane on the nape and throat; suborbital glands are present, but those of the hind pasterns are usually absent. The young show very little trace of the spotted pattern.

The Sambar occurs in India from Ceylon and the Indian peninsula eastward at lower and medium elevations to the Pacific coast of China and in certain of the East Indian islands to the Philippines. Like many other species of tropical and subtropical distribution, it just reaches the extreme southern provinces of China, and has been given subspecific rank, although its real distinctness from the Indian animal is hardly more than suppositional. A race also occurs on Formosa, but it may not be native there.

483. ***Rusa unicolor dejeani*** Pousargues**DEJEAN'S SAMBAR**

Rusa dejeani Pousargues, *Bull. Mus. d'Hist. Nat.*, Paris, vol. 2, no. 1, p. 12, 1896.

?*Cervus equinus* Swinhoe, *Proc. Zool. Soc. London*, 1869, p. 656. Hainan.

Cervus dejeani R. Ward, *Records of Big Game*, ed. 2, p. 22, 1896.

Cervus unicolor dejeani Lydekker, *Deer of All Lands*, p. 156, 1898; *Cat. Ungulate Mamm. Brit. Mus.*, vol. 4, p. 82, 1915.

Rusa unicolor dejeani G. M. Allen, *Amer. Mus. Novitates*, no. 430, p. 15, 1930.

Type specimen.—A skin and skull, (presumably) in the Muséum d'Histoire Naturelle at Paris, number not given, a male, from near Tatsienlu, latitude 30° north, Szechwan, China. Collected by R. P. Dejean about 1895.

Description.—According to Pousargues, its describer, this is as large as the Indian Sambar, but its color is a much darker brown, the tail more thickly haired, the antlers like those of the Formosan sambar.

An adult female taken by Dr. R. C. Andrews near Likiang, Yunnan, has a coarse and stiff pelage with full bushy tail. The forehead and backs of the ears are grayish brown; a patch of darker clear brown behind the rhinarium extends as a narrow median line back to the level of the eyes, which are surrounded by a broad ring of dull ochraceous; chin, except for a dark-brown spot in front of the angle of the jaw, dull white, passing into pale drab on the throat; neck drab-brown, becoming darker and tinged with ochraceous posteriorly, especially on the haunches. There is no whitish rump-patch, but the body generally is dark brown, becoming brighter or more rusty on the haunches with the admixture of ochraceous; tail rusty brown at the base, its terminal two-thirds nearly black. The feet are pale, nearly buff, with a trace of a dark median stripe down the front, while the metatarsal gland is surrounded by a pale rusty ring. Axillary and inguinal regions, and the edge of the buttocks, white. A male from Watien, Yunnan, is very much darker, with a uniformly rich dark-brown muzzle, cheeks, ears, and neck; the chin and upper throat are whitish. Posteriorly, the rusty tint is darker, extending on to the base of the tail. The feet are pale with an indication of a narrow median stripe as in the female.

A good-sized fawn from the island of Hainan provisionally referred to this race shows a trace of the spotted pattern. The sides of its face and neck are grayish brown, slightly washed with ochraceous; flanks deep ochraceous; a median dark-brown stripe from between the eyes to the root of the tail. Tail blackish brown all around and tufted. Remnants of rows of white spots may be traced; these consist of some three large spots on each shoulder, and above these, three small ones at the edge of the black spinal stripe, while on the haunches on each side is a row of four white spots continuing the outer row of shoulder spots. Chest gray-brown, belly buff; axilla and groin white including the inner sides of the hind legs to the hock. Outer side of the legs of a paler ochraceous than the flanks. On the external side of the metatarsus is a tuft of contrastingly dark-brown hair with a few white hairs. Ears white inside, dark brown outside.

The antlers are of the usual sambar type, as described under the generic characters, but very massive, with "a tendency to develop small supplemental snags." The measurements of the antlers of the type are given in "Rowland Ward's Records of Big Game" (9th edition, 1928) as: length on outside curve, $30\frac{3}{8}$ inches; circumference, $5\frac{1}{2}$; from tip to tip, $15\frac{3}{8}$; number of points, three on each side. A pair in Lord Rothschild's collection also mentioned in the "Records," and said to be from "N. W. China," is a trifle larger, with a length

PLATE XIII



A Kansu Red Deer (*Cervus elaphus kansuensis*), killed at Kweilwacheng, Shansi



Dejean's Sambar (*Rusa unicolor dejeani*), killed at Watien, Yunnan

on outside curve of 31 inches; circumference, 6; tip to tip, 22; greatest distance between opposite antlers, $24\frac{1}{2}$.

Measurements:—Pousargues in his original description records the following measurements for the type: muzzle to base of tail following the curves of the body, 1,050 mm.; height at shoulder, 1,110; height at croup, 1,140. It is thus about the same size as the Indian animal.

The skull of an adult male, No. 43062, from Watien, Yunnan, though lacking the premaxillaries, presents the following measurements: occiput to tip of nasals, 340 mm.; right nasal, length, 125; zygomatic width, 180; mastoid width, 140; width across forehead, 130; diameter of orbit, 55; width across molar rows, 115; upper cheek teeth, 115; length of left antler following outer curve, 650; length of its basal prong from base of burr to tip, 335; circumference of burr (left), 225; circumference of antler just above burr, 182.

Occurrence and Habits:—Sambar are found in small numbers throughout much of Yunnan and southern Szechwan as far north as the country about Tatsienlu, the type locality of *R. dejeani*, and eastward along the southern Chinese border to the island of Hainan. It remains to be shown how different this eastern animal is from *C. unicolor*, type locality Ceylon, for the name was given provisionally without much comparison. Nevertheless, the presumption is that it would be racially distinct. In Szechwan the sambar occurs west of Tatsienlu around Litang as far westward as Batang (Brooke Dolan); and northward to the high mountains west of Lifanting, according to E. H. Wilson (1913, vol. 2, p. 163). The same author quotes Major M'Neill as having seen a hind and calf west of Tatsienlu. The hind looked so black among the scrub that at first it was mistaken for a bear, and Wilson calls it the "Black Deer," giving as its Chinese name, "hei lu-tsze." Antlers said to come from Yunnan may be seen, he writes, in any large medicine shop in Chungking, Suifu, and other cities. The extent of the trade in deer antlers in the velvet for medicinal purposes is very large, and Wilson has given some surprising figures of the annual export of these. He states that a large part comes from the little-known region lying between the upper Min River and the Tibetan frontier, where virgin forests still remain in these high ranges. The upper limits of these forests are the home of deer, but owing to the difficulty of access are seldom visited by foreigners. Dr. R. C. Andrews found sambar in the forests near Mucheng, Yunnan, where they are much hunted by the natives who use dogs to drive them. A female that was killed weighed "at least five hundred pounds." He found sambar again near the village of Watien in southern Yunnan, and his companion, Edmund Heller, succeeded in securing a fine male with antlers of 27 inches. The animals are shy, feeding by night and spending the day in the thick cover of ravine bottoms where good dogs and

beaters are necessary to drive them out. Dr. W. H. Osgood (1932) records one brought back by the Kelley-Roosevelts Expedition from Chiulung, to the southwest of Tatsienlu. The Roosevelt brothers (1929) write that from leaving Bhamo on the Burma border till they reached Ningyuan they were rarely out of sambar country, and found sign at altitudes of from 4,000-14,000 feet.

Little is known of the distribution of this deer in eastern China, but it occurs in Kwangtung and probably to the westward as well. In the northern part of Kwangtung, Mell (1922) writes that it is not rare in the mountain forests, and mentions specimens secured from east of Pak Shan as well as from "Tea Mountain," "Spring Mountain" and "Dragon's Head" (translation of the native names). Of two females, one weighed 130 kilograms, and a second 126 kilograms. The latter, killed March 5, was carrying a small embryo of 1.35 kilograms, from which Mell concluded that the breeding season may be in January. Other immature individuals were from the peak of Lunghaotong and from Siuhang.

The sambar is found also on the island of Hainan, whence it was recorded by Swinhoe (1869, p. 656) many years ago. The Chinese call it "twahé" or Mountain Horse. A youngish specimen was secured at Namfong by Mr. Clifford H. Pope in mid-March, 1923, so that it must have been born earlier than the young one mentioned by Mell would have been. Lydekker in his "Catalogue of Ungulate Mammals" refers the Hainan Sambar to *R. unicolor equinus*, the type locality of which is Sumatra, and mentions an imperfect skin from Hainan collected by Swinhoe and still in the British Museum. In view of the fact that no proper comparisons have been made between the island animal and that of eastern China, it is perhaps doubtful whether it is of one race or the other, but may for the present be included here. Mr. Pope writes that this deer is common in the grass- and forest-covered mountains south of Namfong, where annually in February the Chinese go to hunt it. Numbers of hides were seen for sale in the market at that place. A related race occurs on the island of Formosa—*Rusa unicolor swinhoei*.

Specimens examined:—Three, as follows:

Yunnan: Likiang, 1; Watien, 1.

Hainan: Namfong, 1.

Genus *Rucervus* Hodgson

Rucervus Hodgson, Ann. Nat. Hist., ser. 1, vol. 1, p. 154, 1838. Lydekker, Cat. Ungulate Mamm. Brit. Mus., vol. 4, p. 92, 1915 (subgenus). Thomas, Journ. Bombay Nat. Hist. Soc., vol. 25, p. 362, 1918 (genus). *Panolia* Gray, List Mamm. Brit. Mus., p. 180, 1843.

These are large deer, with short tails, and lacking a well-defined rump-patch; the coat is thus of nearly uniform color, the neck with a slight mane. Suborbital glands are present, but the pasterns, as in *Rusa*, are without glands,

and the metatarsal glands may also be wanting. Upper canines present but small. The more obvious distinctions lie in the antlers of the male, in which the brow tine is large, simple and more or less continuous with the posterior beam, making with it a sweeping curve or a very wide angle. The posterior branch forks high up so that the bez and trez tines are usually said to be absent, but the true explanation is probably that the interval between the first and second forks is short in the *Cervus* group, while in the *Rusina* group it is long.

The relationships of this group seem to be rather with *Rusa* than with *Cervus*, and in most general works it is usual to regard *Rucervus* as a subgenus of the latter, whereas it is more probably a subgenus of *Rusa*. Until the entire question can be more exhaustively treated, however, I would follow Thomas in giving it generic rank. The type species is *Cervus duvaucelii* Cuvier, the Indian Swamp Deer or Barasingha, which is not known to occur in China. Two other species, however, are recorded from the extreme southern borders of the country, which may be distinguished as follows:

KEY TO CHINESE SPECIES OF *Rucervus*

- A. Posterior beam of the antlers several times dichotomously forked. . . *Rucervus schomburgki*
- B. Posterior beam with a main beam and several small snags, the tip slightly palmate. *R. platyceros hainanus*

484. *Rucervus schomburgki* (Blyth)

SCHOMBURGK'S DEER

Cervus or *Rucervus schomburgki* Blyth, Proc. Zool. Soc. London, 1863, p. 155. Lydekker, Cat. Ungulate Mamm. Brit. Mus., vol. 4, p. 97, fig. 19, 1915.

Rucervus schomburgkii Fitzinger, Sitzungsab. Kaiserl. Akad. Wiss., Wien, math-nat. classe, vol. 79, pt. 1, p. 64, 1879.

Type specimens.—The cotypes are two pairs of antlers from Siam, now in the British Museum, Nos. 91.12.2.1 and 91.12.2.2.

Description.—Lydekker (1915) describes this deer as about three feet five inches at the shoulder, the coat in winter rather long and coarse, of a nearly uniform brown, darkest on the nose and upper surface of the tail, paler on the cheeks and flanks, with the lower lip, under surface of body and of tail whitish. A tinge of rufous colors the upper lip, back of head and limbs. The hair on the lower part of the fore legs is lengthened to form a fringe. The antlers of the male are of distinctive form. When fully developed, there is a pointed brow tine sweeping forward and upward, while the posterior main beam forks at a considerable distance from the base into a Y with its branches in an antero-posterior plane. Each arm of the Y then forks again, and then a second time, making an evenly dichotomous arrangement of remarkable symmetry, the terminal points long and cylindrical.

The cranial characters appear to be not very different from those of *Rusa*.

Measurements.—No measurements in detail of body or skull are available beyond the statement of Lydekker that it stands three feet five inches high at the shoulder. The record antlers, according to Ward's list, are in the John C. Phillips Collection of the Museum of Comparative Zoölogy, and measure in length on the outside curve, 35.5 inches.

Occurrence and Habits.—This rare deer has at the present time a very limited range in Siam, between "latitudes 15° and 17° North and longitudes 101° and 103° East," according to "Rowland Ward's Records." A recent account of its general status has been published by R. Pigot (Journ. Siam Soc. Nat. Hist., suppl., vol. 8, pp. 51-54, 1929). The only claim for Schomburgk's Deer to a place in the Chinese fauna rests on the specimen mentioned by Bentham (1908) and figured by him in his illustrated catalogue of the Asiatic horns and antlers in the Indian Museum at Calcutta. This is a pair of antlers collected by Dr. John Anderson in 1878 in the Sanda valley, about fifty miles east-northeast of Bhamo, Burma. Anderson does not mention the species in his account of the zoological collections made during his Yunnan expeditions, and it is possible, as Bentham suggests, that some mistake has been made, or that it was secured from the natives and might have come from elsewhere. There is no evidence otherwise that the animal is found within a long distance of Yunnan.

Specimens examined.—None.

485. *Rucervus platyceros hainanus* Thomas

HAINAN PANOLIA DEER

Rucervus platyceros hainanus Thomas, Journ. Bombay Nat. Hist. Soc., vol. 25, p. 364, 1918.

Panolis eldi Swinhoe, Proc. Zool. Soc. London, 1869, pp. 653-656, figs. 1-5.

Panolis platyceros Blyth, in Swinhoe, Proc. Zool. Soc. London, 1869, p. 656.

Panolis frontalis (Hodgson), *Cervus eldi* (Guthrie) Swinhoe, Proc. Zool. Soc. London, 1870, p. 644.

Panolis eldi platyceros J. A. Allen, Bull. Amer. Mus. Nat. Hist., vol. 22, p. 468, 1906.

Cervus eldi siamensis Lydekker, Cat. Ungulate Mamm. Brit. Mus., vol. 4, p. 104, 1915 (in part).

Type specimen.—The frontlet and horns said to be of a five-year-old male (figured by Swinhoe, Proc. Zool. Soc. London, 1869, p. 655, fig. 2), No. 70.2.10.72, British Museum, from the island of Hainan (not Formosa as stated by Lydekker, 1915, p. 104).

Description.—The general color, according to Lydekker, is reddish at all seasons, with pale spots along the middle of the back and sometimes on the sides. The chief distinctions on which this island race is based are that the size is less than in the typical *R. platyceros* of Siam and the basal snags are less developed, only one in five specimens having a button-like basal snag on both

sides, whereas in the typical race the antlers are roughened and there may be from two to five such small extra points. Additional distinctions of this and the typical race from typical *P. eldi* of Manipur are the hairy instead of naked pasterns and the slightly palmate terminal part of the main beam of the antlers.

Measurements:—None available.

Nomenclature:—Lydekker in his review of the ungulate mammals of the British Museum placed these deer in the genus *Cervus*, and since the name *Cervus platyceros* had been used by Cuvier in 1798 for another deer, he found it necessary to propose the new name *C. e. siamensis* for the eastern Panolia Deer, and included in this race the Hainan animal. The latter was by Thomas three years later (1918a) regarded as a distinct island race for which the new name *R. p. hainanus* was proposed. As this author points out, if *Rucervus* is used as the generic name, Gray's *Panolia* (= *Rucervus*) *platyceros* is not invalidated by Cuvier's *Cervus platyceros*.

Occurrence and Habits:—This tropical and subtropical species is certainly known in Chinese territory by the Hainan race only. Swinhoe in the late sixties obtained skins of a doe and fawn as well as five pairs of antlers and two unmated ones from Hainan, all of which were acquired by the British Museum. In 1918 the island race was distinguished and named by Thomas, chiefly on the basis of its smaller and less-developed antlers. In 1923 Mr. Clifford H. Pope obtained the skin of an immature animal at Namfong, but he writes that it is not abundant in that part of the island, although he was told by his Chinese hunter that they might be found in the low grassy country thirty miles southeast of Nodoa. Whether or not this deer or a related race is present on the mainland of southern China is perhaps uncertain. At all events, P. L. Sclater (Proc. Zool. Soc. London, 1895, p. 520) records that a young male Panolia Deer, *Cervus eldi*, from "southern China" was presented to the Zoological Society of London in May, 1895, the second ever to have been received by the Society. It very likely came from Hainan.

Specimens examined:—One skin, from Namfong, Hainan.

Genus *Elaphurus* Milne-Edwards

Elaphurus Milne-Edwards, Ann. des Sci. Nat., Zool., ser. 5, vol. 5, p. 380, 1866. Pocock, Proc. Zool. Soc. London, 1910, p. 945; *ibid.*, 1923, p. 181.

Cervus Sclater, Trans. Zool. Soc. London, vol. 7, p. 331, 1871; *et al.* (not of Linnaeus).

Although placed by some authors in the genus *Cervus*, this deer is very different in its external characters, and no doubt deserves separate generic rank, as at first accorded it by Milne-Edwards. Like *Cervus*, it is of large size, and has the lateral metacarpals represented by their proximal ends only.

The large naked rhinarium is deep and broad below the nostrils, with its upper border deeply concave. The ears are of medium length, well-haired inside, the tail long and bushy, the skull rather narrow and long. The suborbital gland is of moderate size, but there are no foot glands. Hoofs and lateral hoofs large. The upper canines are present but small. The manner of branching of the antlers is peculiar in that the anterior brow tine comes off high up on the beam and is forked once or twice. Conspicuous characters are the narrowness of palate and rostrum, and the much compressed and narrowed posterior nasal openings.

The winter coat is almost uniform in its dull grayish-buff tone in the adult, but the young show the usual spotted condition.

The single species of this genus is the only one known, but its original home is problematical, since the animal has been long extinct in a wild state, though preserved for an unknown period in the gardens of the Summer Palace at Peiping.

486. *Elaphurus davidianus* Milne-Edwards

PÈRE DAVID'S DEER

Elaphurus davidianus Milne-Edwards, Ann. des Sci. Nat., Zool., ser. 5, vol. 5, p. 382, 1866; in David, Nouv. Arch. Mus. d'Hist. Nat. Paris, vol. 2, Bull., p. 27, 1866. Pocock, Proc. Zool. Soc. London, 1912, p. 777; *ibid.*, 1923, p. 186.

Cervus tarandoides David, Nouv. Arch. Mus. d'Hist. Nat. Paris, vol. 3, Bull., p. 28, 1867.

Cervus (Elaphurus) davidianus Milne-Edwards, Recherches pour servir à l'Hist. Nat. des Mammifères, p. 180, 1868-74.

Cervus davidianus Sclater, Trans. Zool. Soc. London, vol. 7, p. 331, 1871.

Cervus (Rucervus) menziesianus Sowerby, China Journ., vol. 19, p. 141, pl. facing p. 142, figs. 1 (the type)—5 (above), Sept., 1933. Near Anyang, Honan.

Type specimen.—An adult male sent to the Muséum d'Histoire Naturelle at Paris by Père Armand David about 1866. It was from the gardens of the Summer Palace at Peiping, Hopei, China.

Description.—In winter pelage the coat is of a nearly uniform grayish buff, in detail as follows: the top of the muzzle is short-haired, the hairs brown at base with pale, buffy tips which become longer farther back on the forehead and occiput, giving these parts a buffy tone; an indistinctly defined eye-ring and the borders of the suborbital gland are clear pale buff. A mane of coarser, longer, brown hair extends down the nape to the withers, and the hair of the center of the throat is also long and a darker brown. Sides of the neck, the back and flanks with buff-tipped hairs having brown bases; haunches and rump clearer, becoming uniform pale buffy to almost white posteriorly. Tail with its terminal tuft of longer hair extending to the level of the hock, buffy in its basal half, becoming brown terminally. Legs from the knee and the lower tibia paler, becoming clear pale buff, this tint also extending to the belly. The ears are like the occiput in color posteriorly, thickly lined with long buffy hair.

The summer pelage is reddish tawny tinged with gray, and is much shorter and sparser than that of winter.

The antlers, which are absent in the females, are of unusual form. The beam at a short distance from the skull, forks, the anterior arm of the fork, corresponding to the brow tine, continuing the upward direction of the base instead of forming a down-curving branch like the usual cervine brow tine. This branch again forks, making two long tines, one anterior and one posterior, of about equal length, with a few short irregular snags on the ventral side. The posterior branch of the first (basal) fork corresponds to the main beam of the antler in *Cervus* and is continued nearly straight out posteriorly, with (in one specimen examined) a short lateral branch at some inches below the tip, and, in the best-developed heads, several short incurved snags on the outer side.

The young are said to be "reddish brown with a tinge of yellow" and "at first profusely spotted with white" (Lydekker, 1915).

In the skull the great length and narrowness of the rostrum are the impressive features. The premaxillæ are in close contact with the entire anterior half of the anteroventral border of the nasals, while the latter at their posteroventral border bound a long narrow vacuity above the lachrymal. The accessory inner column of the upper molars is unusually flattened and long in an anteroposterior direction. Another very striking feature of the skull in comparison with that of *Cervus* is the narrow palate and the very deep and narrow opening of the posterior nares which is much compressed from side to side.

Measurements:—No detailed body measurements are available. Lydekker writes, however, that the size is about that of a large Red Deer, some 3 feet 9 inches at the shoulder. "Fine antlers measure from 28 to $35\frac{5}{8}$ inches along the outer curve, with a basal girth of from $4\frac{3}{4}$ to $7\frac{1}{2}$ inches, and a tip-to-tip interval ranging from $13\frac{5}{8}$ to $27\frac{1}{4}$ inches."

The cranial measurements of an adult male, just losing the last milk molars (No. 8733 M.C.Z.), are: greatest length, occiput to tip of rostrum, 420 mm.; basal length, 367; palatal length, 250; zygomatic width, below orbit, 150; mastoid width, 117; width outside molars, 100; upper cheek teeth, 126; lower cheek teeth, 135; orbit to tip of rostrum, 250; nasals, greatest length, 145, combined width, 60.

General Notes:—Pocock has published accounts of the external characters (1910, 1912, 1923a), and has figured the feet from a specimen that died in the London Zoological Gardens. He shows that in the fore foot a naked area runs upward posteriorly between the toes to the level of the lateral toes, which in his specimen are shown as very narrow and long. The great length is perhaps in part a result of captivity under conditions preventing wear, for in a specimen in the Museum of Comparative Zoölogy they do not attain such

length. He finds that the metatarsal gland may be wanting; at least it was not present in the female he examined. The formation of the penis does not differ essentially from that of other typical Old World cervines, being truncated "apically and provided with five pairs of lobes which normally fold over the urogenital orifice, but are capable of spreading out like the petals of a flower," quite in contrast to the condition in the New World deer in which this organ is merely attenuated at the apex. This bit of evidence, he says, establishes the affinity of the genus with the typical Old World deer, instead of with the American genera "with which Lydekker affiliated it."

The summer pelage, according to Pocock's notes, is carried for a brief three or four months, from May or June to August or September, and he instances a stag in the London Zoological Gardens, which in one year assumed this reddish pelage in May, but in the following year no signs of it appeared until late in July.

There is considerable variation in the time of shedding the antlers and the growing of the new set, with some evidence that adult animals may regularly produce two sets within a year. Pocock summarizes this unusual procedure from notes sent him by Lord Tavistock relating to the herd at Woburn. It appears that "no immature stag grows more than one pair of antlers in a year. The antlers of a yearling are not clean till the end of June and are shed in mid-winter or even later. The antlers of a four-year-old stag are shed early in November, and may not be clean for three weeks after those of the old stags have lost their velvet. All old stags clean and shed their summer antlers with as little variation as to date as red deer. But the date of the cleaning and shedding of their winter antlers is exceedingly variable. In the case of late shedding of the winter antlers, stags will sometimes be found in May with but very few inches of new velvet-covered antlers; but, no matter how small the growth, these antlers will harden and clean in time for the rutting season. These stumpy-horned stags, however, have very poor chance against their better-armed companions, and it is only when the latter are exhausted at the end of the season that the former have any chance of collecting a harem." Very large antlers are said to be always the result of a winter growth by an adult, but the longer the deer have remained in England, the rarer is the production of a single pair of large antlers instead of two pair of smaller ones. The tendency, then, to produce a set of winter antlers may be a recently acquired trait, perhaps correlated with abundance of food and lack of the natural activity of life in a wild state. Usually there is no attempt to resume the rut with the hardening of the winter antlers, but Lord Tavistock knew of two stags that for several seasons resumed their calling in midwinter at Woburn. Ordinarily such mating behavior is all over by November at the latest. The young are usually born in April and May, very late ones being

uncommon. Zukowsky (1922), in an account of a stag in the Zoölogical Gardens at Stellingen, also noted the growth of two sets of antlers in a year, and gives the following dates when they were shed: March 8 and September 18, 1913; March 17 and October 5, 1914. Lydekker (1902a) has published photographs showing the two annual sets of antlers.

Occurrence and Habits:—The history of this remarkable deer is well known. It seems first to have been brought to the notice of Europeans by Père Armand David who in 1866 sent a specimen to the Paris Museum, where it was promptly described by Milne-Edwards and named in honor of that indefatigable collector, who, himself, later referred to it under a new name of his own, *Cervus tarandoides*, in reference to its peculiarly branched antlers in which the anterior fork is sub-branched as in reindeer. The name is, however, antedated by that of Milne-Edwards. David's animal, like all others from China, was one of the herd which for an unknown period had lived in the enclosed Imperial Hunting Park south of Peiping. According to information received later, David (1898) in a letter to Oustalet notes that the species had not apparently been known in a wild state since several centuries before the Christian era! Shortly after Père David's specimen was secured, attempts were made by Sir Rutherford Alcock and Consul Robert Swinhoe to obtain living animals for the London Zoological Gardens (Proc. Zool. Soc. London, 1868, p. 530). Attempts to procure young to be raised until they could be shipped alive were at first unsuccessful, but a skin and skeleton of an adult that had died at Peiping were the first specimens to be received in Great Britain, in 1868. Swinhoe (1870b, p. 434) recounts that Sir Rutherford prevailed upon a mandarin to send five fawns in early July to the British Legation, but three of them died due to improper feeding, while two survived on a diet of elm twigs. When about six weeks old they were described as yellowish brown spotted all over with white. By October scarcely a trace of the spotting remained. These two successfully survived a long ocean voyage and eventually reached London alive and well (Proc. Zool. Soc. London, 1869, p. 468). The further history of this pair is unknown to me, but in November, 1883, the same Gardens received another "young pair" purchased from the Société d'Acclimatation of Paris. These had been bred in the Zoölogical Gardens at Berlin from imported parents, so that at that time David's Deer was represented by living animals in at least three European collections. P. L. Sclater in 1895 (Proc. Zool. Soc. London, 1895, p. 688) reports that in a recent visit to the Jardin d'Acclimatation at Paris he had seen there a fine herd, "males, females, and young, six in all." In addition, the Duke of Bedford has for some years maintained a small herd on his estate at Woburn Abbey, England, descendants from the stock of the Imperial Hunting Park near Peiping. This herd in 1922,

a quarter century or more after the first animals were received, numbered forty-seven adults and a dozen fawns, and seemed to be in excellent condition (J. C. Phillips, 1925). The gait of this deer is described by Dr. J. C. Phillips as very peculiar and hard to describe, "slow and stately and accompanied by a loud clicking of the hoofs like caribou," audible at a considerable distance, two hundred yards or more. Two cases of partial albinism have cropped out among this herd. Père David's Deer has been bred to the Red Deer in the London Zoological Gardens and a hybrid fawn obtained (Proc. Zool. Soc. London, 1907, p. 2).

The original home of this deer is unknown, but it is evidently a native of northern latitudes, as shown by the pronounced difference between the summer and winter coats and the length of time during which the latter is carried (eight or nine months). An early note by David himself (1868) states that from very vague information obtained, he inclined to think it **must** have been native to the country southwest of Koko Nor as well as to the eastern part of Manchuria. S. W. Bushell (1898) writes of its former abundance in the Imperial Hunting Park, which was enclosed by a wall forty-five miles in circuit. In 1894 this wall was broken in many places by the flood of the Hun Ho, and many deer escaped to be killed and eaten by the local natives. David, writing at the same time (1898), adds that during the recent war with the Japanese, Chinese troops had been encamped in this park and had utilized for food all the animals they could kill, so that not a single *Elaphurus* was left. Bushell (1898) further states that a Chinese author of the early part of the 1700's said that the species was originally native to Kashgaria, but this may be doubtful. At all events, it is now extinct except for those preserved in Europe. Mention may be made of a note by Thomas (1904, p. 83), who exhibited a sketch before the Zoological Society of London purporting to represent David's Deer, drawn by a Japanese artist in Hainan, but subsequent inquiries (*ibid.*, p. 178) seemed to indicate that the figure was fanciful, so that no grounds exist for thinking the species ever occurred on that island. A supposed fossil antler is described and figured in the Zoological Magazine, Tokyo, by Watase (1913) as having been discovered in Japan.

Quite recently new light has been shed on the problematical home of this deer by Sowerby (1933c) in a report on some fragments of deer antlers recovered in the course of archaeological excavations carried on in the "Waste of Yin" near Anyang, Honan, by Dr. Li Chi and his associates. One of these fragments Sowerby identifies as *Elaphurus*, and it is unmistakably the long straight backward branch with a portion of the anterior branch from near the base of the antler. A second piece figured in his plate he called *Cervus kansuensis*, but it is more likely *Elaphurus* again, and includes a smaller portion with the burr and parts of the right angle formed by the two first branches of the antler.



Antlers of Père David's Deer (*Elaphurus davidianus*). Upper figure shows an unusually well-developed head, ranked fourth best in Rowland Ward's list, in which the posterior branch of the front fork and the large posterior beam have each a series of small recurved snags on their outer side near the tip. This portion corresponds to the antler fragment made by Sowerby the type of *Cervus* (*Rucervus*) *menziesianus*. The lower figures show, in side view and from above, a set of the more usual type of antlers in this species. Both sets are from park-bred stock, and are in the Phillips Collection of the Museum of Comparative Zoology.

A third portion is as unmistakably the basal part of a roebuck's antler showing the "pearling." The remaining five fragments shown are short sections with small snags coming off on the outer side of a terminal piece of antler. In the one the three short snags form a series evenly spaced and decreasing in size toward the tip, while the other, the type of the supposed new species *Cervus* (*Rucervus*) *menziesianus*, is similar but with much longer snags which tend to curve around and be parallel to the main beam, while the middle and shortest one is forked. These pieces almost exactly duplicate the conditions shown by the posterior fork of the brow tine, and the posterior fork of the main beam, respectively, in a set of *Elaphurus* antlers in the Phillips collection in the Museum of Comparative Zoölogy, and reckoned as the fourth best in Ward's list of heads (see Plate XIV). So close is this correspondence that there can be no doubt whatever of the identity of the fragments, a result which might not have been suspected had less-developed antlers only been used for comparison, for these do not show the extra series of short tines on the outer tips of the two branches mentioned. Sowerby writes that the animals represented by these antlers were probably killed by man, or at least that the antlers were handled by him before being buried in the pit in which they were found, as proved by the way some of them were sawn off at one end, or sharpened to a point with some cutting instrument. The fragment taken as the type specimen of the supposed new deer further has inscribed on it characters of the Shang period, which, if genuine, would date the remains from early Chinese history, about four thousand years ago. Sowerby believes that this deer "was an inhabitant of the swampy reed covered plains that must have existed over the greater part of North-eastern China (present day Chihli or Hopei, Shantung and Honan) before man brought them under cultivation, and that it was slowly exterminated as these plains became completely settled, and the swamps were reclaimed, only a few being saved through being preserved in the famous hunting park in the Nan Hai-tze near Peking."

The Chinese name for this deer, "ssu-pu-hsiang," means "the four unlikes," that is, with the tail of an ass, the hoofs of a cow, the neck of a camel, and the antlers of a stag!

Specimens examined:—A mounted skin and skull, a skeleton, and two sets of antlers (M.C.Z.), all probably from British-bred stock.

Genus *Cervus* Linnæus

Cervus Linnæus, Syst. Nat., ed. 10, vol. 1, p. 66, 1758. Lydekker, Cat. Ungulate Mamm. Brit. Mus., vol. 4, p. 46, 1915.

The genus *Cervus* is typified by the Red Deer, *Cervus elaphus*, of Europe, of which the type locality is taken as southern Sweden. Formerly used to

include almost all the known kinds of deer, it has gradually become more and more circumscribed through the withdrawal of one and another group as separate genera, until, as at present restricted, it contains those species of medium or large size in which the antlers in the male consist of a long cylindrical main beam with a brow tine above the burr and at least three other short tines coming off at an angle; there is a large naked rhinarium or muffle, a short tail, usually no interdigital gland on the fore feet nor on the hind pasterns (such as are present in the Axis and the Hog Deer), and the young have a spotted and striped coat. Lydekker (1915) divides the genus into six subgenera, differing in the type of antler, presence or absence of foot glands, upper canines and in other details. Others would regard these subgenera as of generic rank. Recently Flerov has added a seventh subgenus for the stiff-haired White-lipped Deer of Tibet. Between these two extreme views, a middle course may be best. Withdrawing the more or less tropical Sambar to form a separate genus, *Rusa*, and the Thamin, the Swamp Deer, and Schomburgk's Deer to constitute the genus *Rucervus*, as already defined, leaves in *Cervus* several Chinese and Mongolian species, of relatively close relationship, which again may be regarded as constituting three subgenera. The most primitive of these is the subgenus *Sika*, which retains small size, a more or less spotted coat in the adult, and relatively simple antlers of four or rarely five points, with the first internode between the brow and the "bez" or second tine relatively long; the White-lipped Deer may be thought of as slightly less progressive than the Red Deer in its antlers, which show a similarly long interval between the first and second tines, while the stiff coat and peculiarly flattened skull may be specializations induced through the conditions under which it has developed. It may be regarded as a subgenus of *Cervus*, using Flerov's name *Przewalskium* in that sense. Finally the typical subgenus *Cervus* may be restricted to the species related to the European Red Deer which are progressive in that the internode between the brow tine and the second or "bez" tine of the antlers is very much shortened, so that the two come off very close together and hook forward. This group is of holarctic distribution, occurring across north temperate Europe and Asia, and again in the corresponding area of North America.

Miller (1912) defines the genus *Cervus* in part as including those deer in which the proximal portion of the two lateral metacarpals is retained (plesio-metacarpalian); the hoofs are narrow and elongate, the upper canines present in both sexes but with blunt, low crowns, lower incisors distinctly differentiated in form, a large lachrymal vacuity present and medium-sized suborbital pit; vomer not dividing the posterior narial opening in halves; antlers large and spreading, of cylindrical beam, with a simple brow tine and usually at least (three or) four other tines when fully developed.

Of the genus as thus defined, several species occur in China and Mongolia, which when better known will probably be found to represent one of each of the three subgenera, with one or two subspecies. However, some uncertainty still enshrouds one of these which has been named from cast antlers. The following key may serve to identify the species hitherto recognized from the area in question.

KEY TO CHINESE AND MONGOLIAN SPECIES OF *Cervus*

- A. Antlers with the second ("bez") tine considerably above the brow tine.
- a. Size small, coat spotted with white in the adult and normal in texture..... Subgenus *Sika*
 - a'. Color darker.
 - a''. Dorsal stripe better defined, white spots well developed at all seasons..... *C. nippon mandarinus*
 - b''. Dorsal stripe less well developed, spots on neck less distinct..... *C. nippon kopschi*
 - b'. Color paler..... *C. nippon grassianus*
 - b. Size large, coat stiff and unspotted..... Subgenus *Przewalskium*
 - a'. Upper lip and border of muzzle contrastingly white..... *C. albirostris*
- B. Antlers with the second tine coming off close above the brow tine Subgenus *Cervus*
- a. Belly dark.
 - a'. Hoofs larger, 65 mm. or more on anterior median edge; color darker..... *C. elaphus xanthopygus*
 - b'. Hoofs smaller, 60 mm. or less on anterior median edge; color less dark..... *C. elaphus kansuensis*
 - (?c'. Terminal fork of antlers narrow..... "*C. canadensis wardi*")
 - b. Belly pale..... *C. macneilli*

Subgenus **Sika** Sclater**SIKA DEER**

Sika Sclater, Proc. Zool. Soc. London, 1870, p. 115. Heude, Mém. concern. l'Hist. Nat. de l'Emp. Chin., vol. 2, pt. 1, p. 17, 1888.

Sikaillus Heude, Mém. concern. l'Hist. Nat. de l'Emp. Chin., vol. 4, pt. 2, p. 98, 1898.

The deer of this group are rather smaller than the typical *Cervus*, with which they agree in having a white rump-patch of partly erectile hairs, a metatarsal and suborbital gland, maned throat, no gland on the hind pasterns, and small upper canines. The coat, however, usually has some trace of a spotted pattern in the adult; the naked area on the muzzle is large, and the antlers are small, with a brow tine as in the typical subgenus coming off at an obtuse angle, but the second tine coming off high above it, so that it is often said that the bez tine is lacking; the posterior fork of the main beam consists of but two tines making usually four points (rarely five) in all. The group

ranges across the temperate parts of eastern Asia from southeastern China to Manchuria and Japan. In view of the work of Heude in bestowing a multiplicity of names upon various small variations, and the lack of adequate series for comparison, it is difficult at this time to tell how many valid races occur in China. No doubt, however, Sowerby (1917) is right in reducing the number to two or at most three. Of Swinhoe's *Cervus hortulorum*, based on specimens shot in the gardens of the Summer Palace at Peiping after its sack on October 12, 1860, the true home is now generally accepted as Manchuria, so that the species is omitted from among the list of Chinese mammals. Sowerby (1918) is the only author who has made much comparison of the Chinese races, and has in addition an excellent field knowledge of these animals. He would refer the Chinese forms to three races, one of northeastern China, one of Shansi, and one of South China. These may be tentatively accepted.

487. *Cervus nippon mandarinus* Milne-Edwards

NORTH CHINA SIKA

Cervus mandarinus Milne-Edwards, Recherches pour servir à l'Hist. Nat. des Mammifères, p. 184, pls. 22, 22A, 1868-74 (1871). Sowerby, Ann. Mag. Nat. Hist., ser. 9, vol. 2, p. 121, 1918.

Cervus pseudaxis Sclater, Proc. Zool. Soc. London, 1862, p. 151 (not of Eyndoux and Souleyet).

Cervus (Sika) hortulorum Lydekker, Cat. Ungulate Mamm. Brit. Mus., vol. 4, p. 113, 1915 (in part).

Type specimen.—A male (?mounted) in the Muséum d'Histoire Naturelle at Paris, and said to have come from North China (Lydekker, 1915, p. 114). It was living for a time in the menagerie of the Muséum, so that both its winter and summer coat are figured by Milne-Edwards. A missionary, M. Simon, brought it with other live animals to Paris about 1870.

Description.—A large sika with the coat white-spotted at all seasons and long and shaggy in winter. In color it is said to be darker brown than in typical *C. n. hortulorum*, and the spots less numerous in winter but at that season with the neck and limbs similar in tint to the ground color of the body. Under parts dark. Tail comparatively long, mostly reddish with little white. The dark dorsal stripe is more fully developed than in the race of South China, and the spots are more distinct on the neck.

The antlers have the usual four tines, a brow tine pointing forward at a wide angle, a second tine high up forming the front branch of a fork whose posterior branch again divides into two.

Measurements.—None available.

Occurrence and Habits.—Milne-Edwards recounts the difficulties encountered by the French missionaries in obtaining a specimen of this deer. It was Père Armand David, that indefatigable collector, who heard of its existence in the neighborhood of Peiping, where it was said to be very rare.

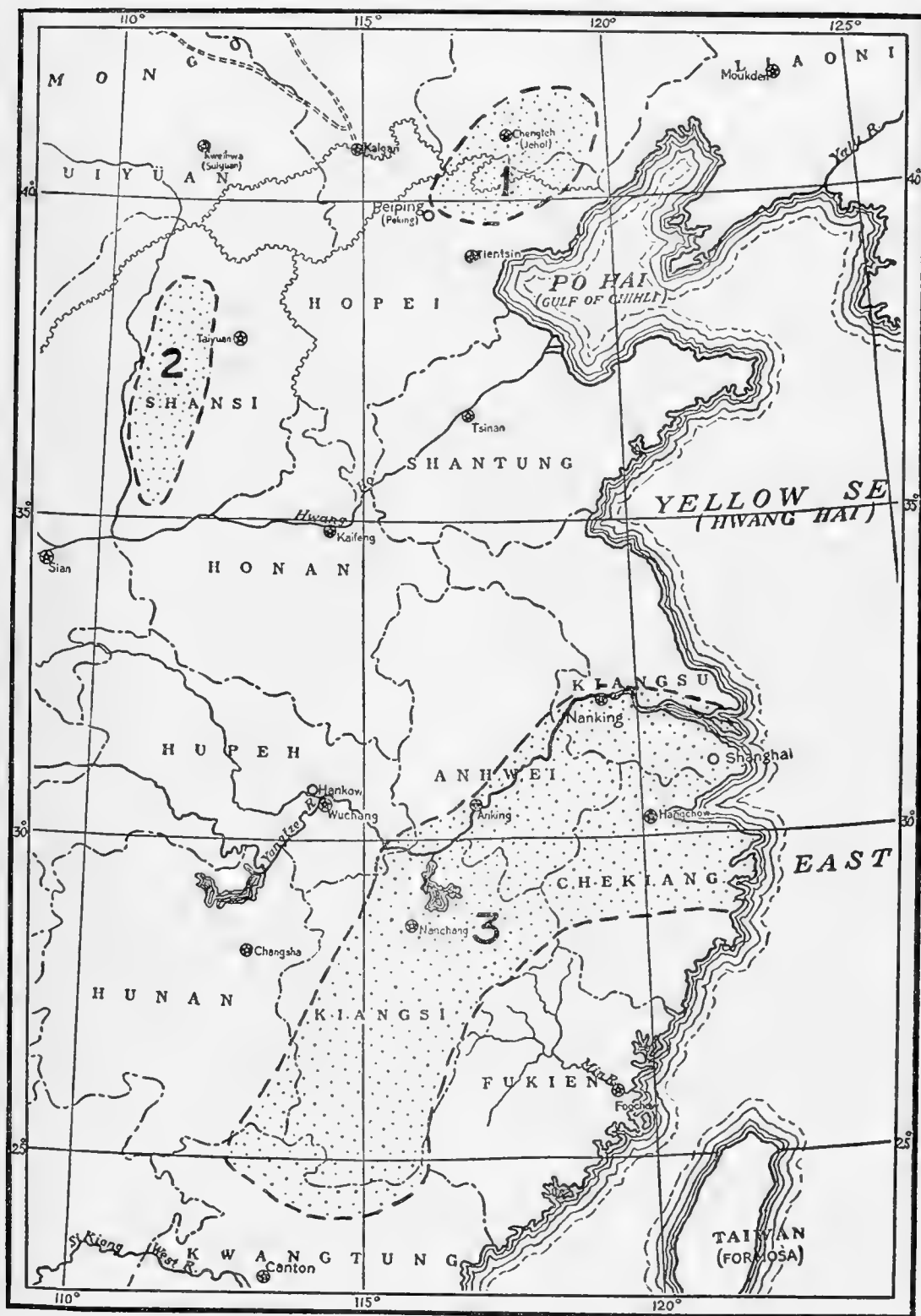


FIG. 67. Distribution Map.
Cervus

1. *C. nippon mandarinus*

2. *C. nippon grassianus*

3. *C. nippon kopschi*

With characteristic zeal, David undertook to procure one, but when at length his efforts were crowned with success, a mandarin who disliked foreigners had him and his company arrested. At length in 1867 Père David's hunters succeeded in obtaining a fine male, and were busy preparing the skin when another Chinese official seized it, cut it in pieces and carried parts of it away. Nothing daunted, David retrieved what he could of the specimen and sent the fragments to France, but they were insufficient to form a proper basis of comparison. Fortunately, at about this time, M. Simon, in charge of a government mission to the interior of China, brought back a number of live animals, among which Milne-Edwards recognized an individual of this deer, and promptly named it *C. mandarinus* to perpetuate the infamous act of the officials who had robbed Père David of his specimen. No doubt this deer formerly ranged over much of northeastern China, but according to Sowerby (1918) at the time of which he wrote it occurred in a wild state only in the Imperial Hunting Grounds "north of the famous Tung Ling (Eastern Tombs), and in the Wei-ch'ang to the north of Jehol, both in Chihli province, to the north and north-east of Peking. It occurs in a semi-domesticated state in the magnificent park at Jehol." Up to 1911-12 it had been strictly protected, but Manchu soldiers encamped in the preserves were allowed to kill many, and since then native hunters have also been allowed to pursue them, so that the likelihood is that they are now nearly exterminated.

Specimens examined:—None.

488. *Cervus nippon grassianus* (Heude)

SHANSI SIKAI

Sika grassianus Heude, Mém. concern. l'Hist. Nat. de l'Emp. Chin., vol. 1, pt. 3, art. 2, p. 12, 1885; *ibid.*, vol. 4, pt. 4, p. 210, pl. 37, fig. 13, 1899.

Cervus grassianus Sowerby, Ann. Mag. Nat. Hist., ser. 9, vol. 2, p. 119, 1918.

Type specimens:—The original description was based on a fine pair of antlers, and a winter skin of a female, from "northern Shansi," China. The antlers were figured in Heude's paper (1899) and according to Sowerby (1918a) are still in the Sikawei Museum, Shanghai. They came from Tsinglohsien, Shansi, China.

Description:—Sowerby describes this race as "fully as dark as Milne-Edwards's winter figure," of a "general greyish brown on the head, going into brown on the forehead and a pale buff at the base of the horns and the base and backs of the ears, the inside of the ears being white. Nose dark brown; chin dark brown, almost black, with a small white patch on either side. Area round the eye buffy-grey. The general colour gets darker on the neck, but it still retains a wash of buff or ochre. The body is dark greyish brown, with

a slight indication of a darker median dorsal line. The spots are almost invisible, showing up in certain lights and quite invisible in others. The dark greyish brown of the body shades into a rich brown on the back and lower portions of the legs, getting lighter and more ochraceous on the fetlocks. There is a peculiar patch of long white hairs surrounded by black on the outer surface of the hind leg about 6 inches below the heel [marking the metatarsal gland]. The tail is black above, white beneath, the hairs being long and making the tail somewhat bushy. The croup disk is white, edged with black on its upper half, the black joining up with that of the upper tail surface, so that there is no white between the tail and the back. The under surface of the belly and inner surface of thighs are white; the chest is a dark brownish grey." The hinds and young are said to be paler, but no direct comparisons of specimens seem to have been made.

Measurements:—A specimen described by Sowerby (1918a) from one hundred miles southwest of Fenchowfu (=Fencheng), Shansi, measured in the flesh: head and body, 60 inches (1,525 mm.); tail, 8 inches (203 mm.); hind foot, 16.5 inches (418 mm.); ear, 7 inches (178 mm.); height at shoulder, 42 inches (about 1,070 mm.). This adult male weighed about 220 pounds, while the antlers, though past their prime, measured: the right, 19.5 inches (497 mm.); the left, 19.75 inches (502 mm.). Each had four points.

The skull measurements, as given for an adult male by Sowerby, are: condylobasal length, 322 mm.; zygomatic width, 136; interorbital width, 100; length of nasals, 125; width outside molars, 54; greatest width of cranium, 84; upper cheek teeth, 99; lower cheek teeth, 103.

Occurrence and Habits:—This deer was named by Heude in honor of Monseigneur Grassi, a French missionary of Shansi, to whom he seems to have owed the original specimens. He described the skin as of a fine gray-brown in the hind, with a few small clear white spots, spaced. The skin is perhaps no longer in existence, but the antlers of the male, which served as a cotype, are in Shanghai at the Sikawei Museum. The only one who seems to have made any comparison of the Shansi sika with that of other parts of China is Sowerby (1918a), who insists that it is paler in color than that of the Peiping region, and worthy of distinct rank. It is not clear, however, whether the differences are really very marked. The specimen which he describes came from western Shansi, one hundred miles southwest of Fenchowfu, a forested region known as the Ningsianghsien Mountains. Another district from which this deer is known, he adds, is the forested area ninety miles west of Taiyuanfu known as the Chiaocheng Shan; while a third is the forest south of Ningwufu, west of Tsinglohsien and north of Kolanchow, whence Heude's specimens doubtless came. Probably the range formerly included all the forested moun-

tainous parts of western Shansi, but relentless hunting has now brought the animal nearly to the point of extermination.

Sowerby adds that the rutting season is November and December; the antlers are shed about March, and the new growth takes place about the end of July. The new antlers are fully formed in August and September, and it is at this season that the deer are most hunted by the natives.

Specimens examined.—None.

489. *Cervus nippon kopschi* Swinhoe

SOUTH CHINA SIKA

Cervus kopschi Swinhoe, Proc. Zool. Soc. London, 1873, p. 574.

Sika brachyrhinus (p. 2), *joretianus* (p. 2), *cycloceros* (p. 2), *gracilis* (p. 3), *grilloanus* (p. 3), *pouvrelianus* (p. 3), *microdontus* (p. 3), *frinianus* (p. 4), *oxycephalus* (p. 4), *lacrymosus* (p. 4), *yuanus* (p. 5), *andreas* (p. 5) Heude, Mém. concern. l'Hist. Nat. de l'Emp. Chin., vol. 1, pt. 3, art. 2, 1885 (all from Poyang basin and right bank of Yangtze); *ibid.*, vol. 2, pt. 3, pls. 23-26A (antlers illustrated), 1894.

Sika rivierianus Heude, *ibid.*, vol. 2, pt. 3, p. 153, pl. 23, figs. 5-10; pl. 24A, fig. 9; pl. 25B, fig. 8, 1894. Poyang Lake.

Sika dugenianus Heude, *ibid.*, p. 156, pl. 24, figs. 1-4; pl. 24A, figs. 3, 14; pl. 25B, fig. 1, 1894. No locality.

Sika arietinus Heude, *ibid.*, p. 162, pl. 24A, fig. 11; pl. 25B, fig. 10; pl. 26A, figs. 5-8, 1894. No locality.

Cervus hortulorum kopschi Lydekker, Great and Small Game of Europe, p. 239, 1901; Cat. Ungulate Mamm. Brit. Mus., vol. 4, p. 115, 1915.

Pseudaxis oxycephalus Mell, Arch. f. Naturgesch., vol. 88, sect. A, no. 10, p. 30, 1922.

Type specimen.—The type is a mounted skin and the skull of an immature male in winter coat from Kienchang, Kiangsi, near the Fukien border, China, collected by Robert Swinhoe about February 27, 1872, and now in the British Museum.

Description.—In color characters this race apparently resembles the North China race, but the dark dorsal stripe is less developed and the spots on the neck are less distinct (Lydekker). Swinhoe describes the color as of a rich yellowish brown with distinct white spots and long thin reddish tail (living animals said to be from Hankow). It is spotted at all seasons. The type is described by Swinhoe as follows. Hair on the neck rather coarse, on the belly long and curly. A dorsal line, starting between the ears, runs down the back, of a chestnut color to the hind neck, becoming deep umber brown between the shoulders, paler along the back, and deeper again on the rump. Rest of the body above, brown mottled with light yellowish brown. A row of indistinct white spots along the dorsal line. Humerus, sides of belly, and thighs light purplish brown to the knee and the hock, beyond which this color is mixed with yellowish to the foot, where it becomes clear tawny. Belly and inside of the fore legs brownish white, and a deep brown line down the center of the breast. Tail black above, this color extending to the long hairs on the edge of the rump to form a T-shaped mark; below white, this extending to the inguinal region. Head and neck and the backs of the ears brown, the latter

white inside. Under lip near the edge and the throat whitish. A deep-brown spot on the chin.

The canines are small. The antlers, according to Sowerby (1929b), in this race tend to develop a fifth point below the "royals" pointing posteriorly, and this even may fork.

Measurements:—Swinhoe (1873) gives the following measurements of the type:

Muzzle to root of tail.....	4 ft.	4.00 in.	1320 mm.
Height at shoulder.....	2	10.00	863
Thigh joint to tip of toe.....	2	9.00	840
Shoulder joint to tip of toe....	2	6.50	775
Elbow to knee.....	—	10.00	255
Knee to carpal joint.....	—	7.50	193
Carpal joint to hoof.....	—	3.50	90
Tarsal joint to hoof.....	—	3.50	90
Tail to tips of hairs.....	—	8.50	215
Length of head.....	—	10.50	267
Length of ear.....	—	7.00	178
Eye to tip of nose.....	—	5.25	134

No cranial measurements are available. A fine pair of antlers, one of the four specimens described by Heude as *S. oxycephalus*, measured 700 mm. on the length of the curve, and a second from south of Kiente, his "*frinianus*," had a length of 680 mm. Heude gives the length of the upper premolar row as 40 mm. and of the upper molars as 60 mm.

Occurrence and Habits:—The South China or Kopsch's Sika in former times doubtless had a more or less continuous range in eastern China from the Yangtze basin south into northern Kwangtung, and perhaps still farther south. In Père Heude's day, the eighties and early nineties, it was not uncommon in a district of the lower Yangtze including the basin of Poyang Lake and the country about Kiente. From this area he named over a dozen different "species" based on individual variations in the intimate structure of the teeth and in the form or degree of divergence of the antlers. While this multiplicity of names gives some idea of the variability of the characters of these parts, it is clear that all must refer to a single species in the usual sense of the word. Sika are still found in Anhwei in spite of constant persecution by native hunters for the antlers in the velvet, which are prized for supposed medicinal virtues. Swinhoe in 1872 wrote that sportsmen at Shanghai occasionally reported seeing antlered deer on the hills at some distance from that city, doubtless the mountainous country of the Anhwei border, where as recently as 1925 A. N. Steward reports starting "a big white-tailed deer" in open pine forest. In 1842 Cantor recorded the presence of these deer on the island of Chusan off the mouth

of the Yangtze. Heude (1885) wrote that in 1884 an adult male was killed in the Kienping district, and that old inhabitants said there were deer in the Kouangtechow district and in that of K'ing, west of the Great Lake, Taihu, as well as in the department of Kinhwa on the Hangchow River. In recent times the range has become restricted, and it is now rare in the Yangtze valley, where it would long since have been quite exterminated did not hunters use a certain amount of restraint, pursuing it only in the season when its antlers are growing (Sowerby, 1929b). These, according to Sowerby, are considered by the Chinese more valuable than those of any other deer for medicine, and high prices are paid for them. A good pair in summer will fetch as much as forty to seventy pounds or even twice that, selling at the rate of eighty dollars (Mexican) an ounce. The same author, in the article quoted, reproduces an excellent figure of the antlers. In an earlier note the same writer (Sowerby, 1923b, p. 184) mentions a female killed in 1923 just outside the walls of Nanking, having been driven from a reed bed, and in the following year (Sowerby, 1924b, p. 78) a female weighing 54 pounds that was killed between Chinkiang and Nanking. Of the presence of this deer in Fukien and other provinces south of the Yangtze there is little evidence. Mell (1922, p. 30), however, was told of white-spotted deer called "mui-fah-log" in the region of Yannfah and "Logdsong," Kwangtung, and it is well known to the missionaries there who reported seeing specimens brought into the market or which they had themselves killed. He quotes Bowring (Trans. China Branch Asiatic Soc. Hongkong, 1874, p. xix) as to some sent from Canton, but the origin is of course open to question.

Heude (1894, p. 154) recounts having kept a male from Tongliu, Yangtze River, and having bred it to a hybrid between the small Japanese and Formosan Sikas. He believed the young to be more like the male than the female parent.

Owing to constant hunting, this is an exceedingly shy deer, frequenting heavily forested country, although in summer it may descend into open valleys with thick vegetation. Little seems to be known of its habits. It was named by Swinhoe in honor of H. Kopsch, the Customs Commissioner at Kiukiang, through whose efforts in 1872 the type specimen was secured.

Specimens examined:—One immature skull, exact locality unknown.

Subgenus *Przewalskium* Flerov

Przewalskium Flerov, Compt. Rend. Acad. Sci. URSS, 1930A, p. 115 (as a genus).

For the White-lipped Deer, *Cervus albirostris*, Flerov (1930) has recently proposed a special genus, *Przewalskium*, named in honor of the famous explorer Przewalski. The important characters seem to be: the very stiff, coarse pelage, long pointed ears, broad deep hoofs, bez tine high above brow tine,

broad nasals, and rather low cranium. The general type of coloration and the plan of the antlers are, however, not so essentially different from those of the Red Deer, so that at present I would regard this species as not more than subgenerically different from the others of the group. As pointed out by Flerov, its peculiarities may be a result of living in the cold Tibetan uplands, where its food must be largely grass with occasional browse, while the character of its coat may be correlated with the need for protection from the severities of climate through the retention of air in the stiff, quilly hairs. It may be added that the supposed lack of a bez tine is probably merely a matter of interpretation, for this second tine, instead of being close to the brow tine as in *C. elaphus*, is high up on the beam about where the trez comes in the latter, so that instead of being lacking the bez is really present but separated more widely from the base of the antler. This lengthening of the first internode between the basal tines is probably to be thought of as the retention of a primitive character.

490. *Cervus albirostris* Przewalski

WHITE-LIPPED OR THOROLD'S DEER

Cervus albirostris Przewalski, Tibet and Upper Yellow River, p. 124, 1883 (in Russian); *Reisen in Tibet*, pp. 73, 76, 1884. Pousargues, *Mém. Soc. Zool. de France*, vol. 11, p. 215, 1898. Lydekker, *Deer of All Lands*, p. 91, pl. 5, 1898.

Cervus sellatus Przewalski, Tibet and Upper Yellow River, p. 125, 1883 (in Russian).

Cervus thoroldi Blanford, *Proc. Zool. Soc. London*, 1893, p. 444, pl. 34. About two hundred miles northeast of Lhasa, Tibet.

Przewalskium albirostre Flerov, *Compt. Rend. Acad. Sci. URSS*, 1930A, p. 120.

Type specimen.—An adult male, skin No. 1648, skull No. 1488, in the Zoological Museum of the Academy of Sciences at Leningrad, from three kilometers above the mouth of the Kokosu River, a left tributary of the Dank Ho, western Humboldt Mountains, Nan Shan, western Kansu, China. Collected by the Cossack Kalmynin, Przewalski's third expedition, in late June, 1876.

Description.—A large deer standing some four feet three inches at the shoulder, with mixed brownish gray coloring, white lips and coarse pelage, which is sometimes reversed to form a ruff at the withers. A female in winter may be described as of a general dull brown above, nearly "bistre," darkening on the head and neck, the individual hairs with a short terminal band of pale buff, producing a minutely ticked appearance. A narrow buffy rump-patch includes the posterior border of the buttocks and extends forward to take in the tail and an area about 150 mm. in advance of it, where it becomes sharply delimited by the dark blackish brown of the croup. The inside of the ears, the chin and interramal area, the upper lip and end of the muzzle are white.

The hairs of the withers are not reversed in the specimen described, although the tips of those on the neck tend to turn forward. Possibly, as Pocock has suggested, the reversal is characteristic of old hair, and not a valid specific character, or it may occur only in old males. The median area of the tail may be dark, dividing the rump-patch. Flerov (1930) writes that the pelage in summer approaches snuff brown in color, and in winter wood brown; abdomen pale, "lighter than pinkish buff," rump-patch sharply circumscribed, near "sayal brown" or reddish, but possibly this is a result of discoloration. Belly light brownish yellow.

The skull is notable for the wide posterior wings of the nasals, the convex upper profile of the brain case, large lachrymal pits, "almost twice as large as those" in the Red Deer, occupying the entire lachrymal bone. Palate broad and flat instead of concave, the incisive foramina short, less than the length of the orbit. The antlers of the male are "large, strongly flattened towards the top," with a brow tine in front and normally four others, the first, on the front of the beam, high up, beyond which the posterior branch of the fork divides again into two long and nearly equal branches, the posterior of which further divides at its tip into two small tines.

Measurements:—Pousargues (1897) gives the total length from muzzle to tip of tail as 2,100 mm.; tail, 30 mm.; height at shoulder, 1,230. Flerov (1930) gives the following measurements, quoted from Przewalski: total length from end of muzzle to base of tail, about 7 feet; height at shoulder, 4 feet 3 inches. He gives as cranial dimensions (?male): greatest length of skull, 400 mm.; zygomatic width, 195. The skull of a fully adult female from Batang (M.C.Z. No. 21928) shows the following: greatest length, 340 mm.; basal length, 318; palatal length, 202; zygomatic width, 155; mastoid width, 114; width outside molars, 97; upper cheek teeth, 113; lower cheek teeth, 122; orbit to tip of premaxilla, 200; nasals, greatest median length, 138; greatest combined width across posterior portion, 58.

Occurrence and Habits:—The White-lipped Deer is one of the less-known species of the Tibetan plateau fauna, which in its eastward range just reaches the extreme western border of China. An excellent history of it has been written by Pousargues (1897, 1898b), while Flerov's more recent paper (1930) summarizes the characters and recorded specimens and emphasizes its peculiarities by creating for it the special genus *Przewalskium*. It was first met with by the explorer Przewalski who, on his third expedition into eastern Tibet, obtained a male in June, 1876, near the junction of the Kokosu River and the Dank Ho in the western part of the Humboldt Range in Nan Shan. On his fourth expedition, Przewalski obtained a second specimen, a doe, in the southern Koko Nor Mountains, April, 1884, and a second male near the temple "Djow-

dun," near the headwaters of the Yangtze, eastern Tibet, in June of the same year. Another adult male was brought back by V. Roborovski of the Russian Geographic Society expedition from the Koko Nor Mountains, taken in April, 1895. Of these four specimens two are mounted and two are in the study collection of the Zoological Museum of the Academy of Sciences at Leningrad. In 1892 Thorold secured two specimens of this deer from a point about two hundred miles northeast of Lhasa, Tibet, at an altitude of 13,500 feet. The animals were found among brushwood in the snow, just above the forest limit. Of these one is now mounted in the British Museum and is the type of *Cervus thoroldi*, which Pousargues (1897) showed to be a synonym of Przewalski's *C. albirostris*. In addition to these, a head-skin and skull bought in the bazaar at Darjeeling, and recorded by Sclater as *Cervus dybowskii*, are in the Indian Museum, Calcutta. To these may be added the skin and skull of a female which I recorded (G. M. Allen, 1927c, p. 62) as having been taken by Weigold near Batang on the extreme western edge of Szechwan. This specimen, now in the collection of the Museum of Comparative Zoölogy, serves to fill in partially the gap in the known distribution of the species between the Nan Shan localities and the Lhasa region. The white upper lip and border of the muzzle, the coarse pelage (not reversed on the withers in this female), and the characters of the skull with its broad nasals, rather large lachrymal pit, stout cheek teeth, and antlers with the elongate interval above the brow tine (resulting in an apparent absence of a bez tine) are characteristic points of the species. Practically nothing is known of the habits, although Pocock infers from its habitat that it must subsist more on grass than on "browse." Probably, however, it does frequent the scant cover along watercourses or, as Thorold mentions, it may be found in the scrubby growth above timber limits. More definite information has lately been supplied by Mr. Brooke Dolan who met with it on his expedition of 1934-36 to eastern Tibet. He found it "all the way from the Tachienlu Mountains westward into central Tibet and northward probably to the grasslands around the Amnye Machen. They were seen by us to the south of Litang around Batang, and to the northwest of Jyekundo, and tracks were found in the Tachienlu Mountains. However, they have been so persecuted that the stand is down to nothing in many localities. Four or five years ago they were said to have been extremely plentiful around Batang. . . . They range from mid-spruce forest up through rhododendron and dwarf rhododendron to the grasslands just below the peaks, that is, from about 12,000 to 16,000 feet. They occur on the fringes of the high steppes along the scarps of the upper Yangtze River in dwarf rhododendron and willow cover. . . . It is said that the antlers are retained well through the month of March" (Proc. Acad. Nat. Sci., Philadelphia, vol. 90, p. 282, 1939).

Specimens examined:—In addition to the type of *Cervus thoroldi*, a mounted specimen, No. 92.16.11.1, in the British Museum, the following:

Szechwan (Hsikang): near Batang, 1, female (M.C.Z.).

Subgenus **Cervus** Linnæus

Cervus Linnæus, Syst. Nat., ed. 10, vol. 1, p. 66, 1758.

This group includes the more typical elaphine deer, exemplified by the Red Deer of Europe and the Wapiti of North America. In these the "bez" or second tine of the antlers comes off close above the brow tine, and, like it, hooks down and forward. Pocock, in his paper in the Proceedings of the Zoological Society of London (1933, pp. 377-406) on the homologies between the branches of the antlers in the Cervidæ, has very beautifully shown that the branching is on a fundamentally dichotomous system. It seems further probable that one tendency in evolutionary progress is to develop additional forkings in the terminal part of the main beam (usually the posterior fork) and at the same time to reduce the length of the more proximal internodes or portions of the stem of each Y. Thus in the Roe Deer there is a long basal stem before the first fork, after which the posterior tine of the fork divides again into two. In *Cervus* the part corresponding to this basal stem is very much shortened so that the first anterior fork comes almost at the base of the beam to form a "brow" tine and a main posterior branch. In the Sika Deer as in the White-lipped Deer, the posterior branch of the first fork does not again divide until after a considerable interval so that the next tine is high up on the beam, or, as usually stated, there is no "bez" tine. The more typical members of the subgenus *Cervus* have, however, shortened this interval, bringing the "bez" tine close to the brow tine as a progressive character, a condition also seen in the genus *Rangifer*. Pocock has suggested that the "bez" tine is fortuitously added in this case, but the true explanation would seem to be rather that the internode between the two tines is shortened.

The Red Deer of western Europe tends to develop a terminal "cup," formed by a cluster of three or four short points coming off nearly together, and the same may be seen in large antlers of, for example, the Persian Red Deer. The eastern Asiatic races seem to lack this trait, as do also the American Wapiti, and for this reason the former have been by some regarded as derivatives of the American Wapiti, through a reinvasion of eastern Asia by the latter in late geological times. The American animal, however, is differently colored and larger of skull than the eastern races of Asia, and it seems more logical to regard at all events the Chinese and Mongolian Red Deer as but larger races of the same species as found in Europe.

491. *Cervus elaphus xanthopygus* Milne-Edwards

Cervus xanthopygus Milne-Edwards, Ann. des Sci. Nat., Zool., ser. 5, vol. 8, p. 376, 1867; Recherches pour servir à l'Hist. Nat. des Mammifères, p. 181, pl. 21, 1868-74.

Cervus elaphus Radde, Reisen im Süden von Ost-Sibirien, vol. 1, p. 284, 1862.

Cervus bedfordianus Lydekker, Proc. Zool. Soc. London, 1896, p. 932, pls. 48, 49. Manchuria.

Cervus canadensis xanthopygus Lydekker, Great and Small Game of Europe, p. 70, 1901; Cat. Ungulate Mamm. Brit. Mus., vol. 4, p. 133, 1915. G. M. Allen, Amer. Mus. Novitates, no. 430, p. 16, 1930.

Type specimen.—The type is an adult male with antlers from "les environs de Pékin," not Manchuria as stated by Lydekker and is mounted in the Paris Museum, whither it was sent by M. Fontanier about 1867. It is figured in colors by Milne-Edwards (1868-74, pl. 21).

Description.—A large-bodied deer of the *C. elaphus* type, with rather uniform coloration. Lydekker (1915) describes the general color of immature and subadult individuals in summer as "bright reddish brown, in some cases without a distinct rump-patch, in older animals . . . browner; in winter brownish grey with the dark neck-mane and under-parts of typical wapiti." A doe killed August 21 northeast of Urga has practically shed its summer coat, of which scattered ochraceous hairs still remain on the fore shoulder and haunches, while the fresh drab-gray pelage of the new winter coat is still very short. The neck has a decided mixture of buff, and there is a dark-brown line from occiput to withers. The chin is dark brown, pale at the sides in front of the dark mark near the corner of the mouth. In comparison with *C. e. kansuensis* it is decidedly more buffy on the neck, the rump disk is more extensive forward and of a deeper ochraceous, while the hoofs are considerably larger. Milne-Edwards describes the type specimen as much resembling the European *C. elaphus* in the winter pelage, with a similar uniformly colored pelage but paler with a frosted appearance due to the whitish points of the hairs, especially on the flanks. The rump-disk is yellowish, with a tinge of red, extending high on the croup but not far on the buttocks, and is bordered with dark brown. The ears are paler, and the pelage less harsh. It seems evident that the coloring is much more that of the European Red Deer than of the American Wapiti, with, however, a more yellowish rump-patch.

The young in first coat is spotted.

The antlers are relatively small in comparison with the large size of the body, and apparently do not differ essentially from those of European animals, though with little or no tendency to form a terminal cluster of tines or "cup." When fully developed, the brow tine, bez and trez should be present with the usual forked upper portion with a longer backward tine. In the type, as shown in Milne-Edwards's figure, the fully adult condition has not been attained. This author further points out a few minor details in skull characters which may prove to be valid in separating the eastern animal. These are: the smaller size of the lachrymal pits, more inflated and less high suborbital portion of the

maxillary, slightly longer and less flattened nasals. Such characters, however, are likely to show more or less individual variation and cannot be established on a comparison of single skulls. In the type skull Milne-Edwards remarks that the vertical ribs on the outer face of the upper molars are more prominent.

Measurements:—Though the antlers are hardly larger than those of the European (British) Red Deer, the body is considerably greater. In the type specimen Milne-Edwards noted that the height at the shoulder was 1,050 mm., which seems small. The tail, as mounted, measured with its terminal hairs 80 mm. (Pousargues, 1898b, p. 209). The hoofs are, in the doe from near Urga, larger than in *C. e. kansuensis*, measuring 66 mm. along the median edge on the fore foot and 67 on the hind foot, against 53-60 mm. and 60 respectively for the largest specimens of the latter.

Cranial measurements of the adult female from northeast of Urga, No. 46407, are: condylobasal length, 403 mm.; basal length, 367; palatal length, 256; zygomatic width, 163; mastoid width, 119; width across molars, 115; nasals, median length, 155, width, 65; orbit to tip of premaxillæ, 240; upper cheek teeth, 122; lower cheek teeth, 133; upper premolar series, 56. In a young male, with only the milk teeth in place, the upper premolar series measures 63 mm.

It is unfortunate that no good series of external measurements is available.

Nomenclature:—In my preliminary paper of 1930, I followed Lydekker in regarding this deer as a race of the American Wapiti, but I now believe this is a mistake. It is true that the body of the animal is larger than that of European stags, but the antlers are much the same, and the coloration is of the same type, though somewhat darker in winter, and with a yellowish pygal disk. Further, it seems evident that, as with so many other species of similar distribution across northern Asia, it is after all but the eastern representative of the European animal. I am therefore regarding it as a subspecies of the latter. The American Wapiti is much larger of body, with antlers of proportionate size, and with a different coloration, dark neck and contrastingly pale body, instead of a more nearly uniform drab gray in winter, and is not so red in summer. Doubtless, as Lydekker has shown, *Cervus luehdorfi* of Bolau, 1880, described from northern Manchuria, is a synonym, and the same author also admits that his *C. bedfordianus*, type from Manchuria, is the same. It seems likely, too, that Lydekker's *Cervus canadensis baicalensis* (1915, p. 134) is synonymous, based on Matschie's account of a deer from the Syansk and Baikal Mountains west of Lake Baikal. This name was proposed as a substitute for *C. asiaticus*, which Lydekker had previously quoted as from Severtzov, but later recognized was not used in a specific or subspecific sense by that author, so that *C. baicalensis* becomes a synonym of *C. asiaticus* Lydekker. Until more thorough

comparisons can be made with adequate material, it seems futile to attempt the further division of Asiatic Red Deer into local races.

Occurrence and Habits:—Sowerby (1923g) has given an excellent account of this species in Manchuria, where it inhabits forested country and is much persecuted by the Chinese for the antlers in the velvet. It has become very shy and no doubt has been exterminated in parts of the country to the south, so that at present it is apparently not found in Hopei, as one may suppose it formerly was. From Manchuria and the Ussuri region, its range extends westward in northern Mongolia in the strip of forested and mountainous country bordering the northern edge of the Gobi, so that there is at present a complete break to the east and south between its range and that of the Kansu Stag. One may assume that the stags of northern Mongolia and the Transbaikial area are the same, as is the case in other wide-ranging species, although names are now available should they ever be shown to differ locally. The best account of the habits of the species in this region is that of Radde (1862) who spent much effort in gathering information on the mammals of the Siberian border. He mentions local differences in size, without, however, giving measurements, and calls attention to the relatively small but thick antlers. In its general habits it recalls the Red Deer of Europe, frequenting in spring and summer the steeper slopes up to the tree limit, as in the Syansk Mountains. In the winter it descends to the wooded valleys, going in small bands of rarely more than four or five animals. In summer they are more often found solitary. The rutting season takes place from the end of August through the month of September, when the bulls fight fiercely among themselves, and may be lured to the hunter by an imitation of the challenging bellow. By the end of September the winter pelage is appearing. The antlers may be carried until nearly the end of the year, but are usually dropped in October and November. The young calf is born about the end of April. Radde has a number of interesting remarks on the local abundance and scarcity of this deer in various parts of this area, and mentions that in 1859 the Wild Dogs (*Cuon primævus*) in the spring entirely drove out the Red Deer from certain favorite haunts on the middle Irkut.

The antlers are rather stocky and may attain a length of up to 35.5 inches, which is that of a pair from the Sungari district now in the Sikawei Museum. The spread was 22.75 inches, and the number of points eleven (6 and 5). This, as Sowerby (1923) says, is evidently the record head, surpassing the best in Rowland Ward's list by over two inches. In recording this and other specimens Sowerby (1923g) gives a plate of outline drawings of these antlers.

Specimens examined:—Two, an adult female and an immature male, from sixty miles northeast of Urga, Mongolia.

492. *Cervus elaphus kansuensis* Pocock

KANSU RED DEER

Cervus kansuensis Pocock, Proc. Zool. Soc. London, 1912, p. 573. Wallace, Big Game of Central and Western China, pp. 195, 296, 1913.

Cervus macneilli kansuensis Lydekker, The Field (London), vol. 120, p. 860, 1912; Cat. Ungulate Mamm. Brit. Mus., vol. 4, p. 146, 1915.

Cervus canadensis kansuensis G. M. Allen, Amer. Mus. Novitates, no. 430, p. 16, 1930.

Type specimen.—The skin of a female, No. 12.7.26.16, British Museum, from thirty miles southeast of Taochow, Kansu, China, altitude about 11,000 feet. Collected March 23, 1911, by Dr. J. A. C. Smith.

Description.—The skin of the type in late winter, a female, is described by Lydekker as of a general speckled brown above, exclusive of the rump-patch, the tail with an irregular dark median line. A female from northern Shansi, December 13, 1921, has the muzzle, sides of face, neck and body drab gray, each hair gray to pale brown or drab, with a narrow subterminal whitish ring and minute black tip. Forehead slightly washed with yellowish or pale buff (pale ochraceous); area between the ears dark brown, which extends back as a narrow median line to the withers, where the long hairs have a dark or dusky basal part. From the knees to the hoof the front of the leg is a uniform drab, slightly browner than Ridgway's drab; hind foot similar from the upper part of the foot to the hoof. The metatarsal gland, situated at the end of the proximal third of the foot, is marked by a tuft of bright ochraceous hair. The axilla and the inguinal region white. The pygal disk is narrowly white on the posterior side of the buttocks, passing into ochraceous buff dorsally as the area expands. It is bordered laterally by a dark blackish-brown stripe which pales out dorsally and merges with the white-tipped hairs of the back, but extends medially across the pale rump-patch on to the back of the tail as a more or less irregular line, which may in some individuals be much better marked as a wide stripe some 60 mm. across.

The males are somewhat darker than females, with the brown on the legs more extensive; the axilla may be russet, this color extending down on the inside of the fore legs to the back of the hoofs; chest dark brown instead of pale gray, as far as the lower belly, with a pale band on the flanks merging with the darker color of the back. Eye-ring whitish; inside of the ears white, their backs mixed grayish with or without dark edges at the tips. Males have a well-developed crest of longer coarse hairs on the withers.

The summer pelage I have not seen, but it is described by Sowerby (1914) as "of a rich reddish-brown." He adds that the Shansi animals are somewhat intermediate between those of Kansu and the Manchurian race, being less brown than the former, with the rump-patch not white as in the Kansu animal but of a light sandy color. These differences are no doubt

subject to more or less individual variation, but it seems unlikely, as he intimates, that the Shansi stag is racially different from that of Kansu.

In a comparison of Shansi skins with those of northern Mongolia representing *C. e. xanthopygus*, the former are grayer, lack the buffy tint on the neck, and have the rump-patch paler, buffy to white. The hoofs also are somewhat smaller, as noted under the latter race. The antlers, as figured by Wallace (1913, photograph facing p. 206) and by Sowerby (1914, photograph facing p. 26), are of the typical appearance, and less stocky apparently than in *C. e. xanthopygus*. The latter author describes and figures a "magnificent head" obtained by Captain T. Holcomb of the U. S. Marines in northern Shansi, that carried twelve points, and had a length of beam of 41 inches, circumference 9.5 inches, and widest spread 29.5 inches, hence larger than any recorded for the northeastern race.

No cranial characters have been ascertained that would separate the two subspecies.

Measurements.—Wallace (1913) in his excellent account of this deer writes that an adult stag will stand about 57 inches high at the shoulder and weigh about 530 pounds against about 700 for the American Wapiti. The measurements of the 530-pound stag are given by Wallace as follows: total length from nose to tip of tail in a straight line, 75 inches; height at shoulder, 57.5 inches; height at hind quarters, 59.5 inches; girth of body, 65 inches; of neck, 44 inches; hind foot from hock, 22.5 inches; length of ear, 9 inches. The animal was shot in the Min Shan, Kansu.

CRANIAL MEASUREMENTS OF *CERVUS ELAPHUS KANSUENSIS*

No.	Greatest length	Basal length	Palatal length	Zygomatic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Sex	Locality
45470	418	385	255	184	148	111	122	120	♂	Shansi
45471	405	383	260	185	141	109	114	124	♂	Shansi
45472	387	361	245	176	134	109	119	130	♂	Shansi
57112	375	335	225	145	108	108	122	133	♀	Shansi

Nomenclature.—While there is no doubt that the name *C. e. kansuensis* applies to the stag of Kansu and Shansi, there has been some uncertainty as to its real affinities. Lydekker's final conclusion was that it is a dark northern race of the very pale grayish deer of Szechwan which he had previously described as *C. macneilli*. There seems, however, no reason to suppose that the Kansu animal is anything more than a large eastern form of the Red Deer of Europe, closely related to *C. elaphus xanthopygus*, while *C. macneilli* is distinct. As Wallace puts it, the stags of *C. e. kansuensis* resemble "red deer in shape and build, but [are] more uniform in colour, much larger, with the roar

of a Scottish stag and the horns of a wapiti." Another uncertainty enters into the question in connection with the identification of the name *Cervus canadensis wardi* Lydekker, 1910, based on a pair, perhaps not mated, of antlers from the Szechwan border of Tibet. These resemble those of Tien Shan and Syansk Wapiti, but "are lighter and more slender, . . . with the terminal fork narrower, and the fourth tine smaller." Lydekker (1915) suggests that these may prove to belong to his *C. macneilli*, a conclusion which now seems justified.

Occurrence and Habits:—The range of this large race of Red Deer was probably at one time continuous with that of the northern *C. e. xanthopygus* to the eastward of the Gobi, but there seems to be at the present time a wide hiatus, including Hopei, separating the two. This is perhaps due to the clearing of the intermediate country with human settlement and partly to climatic changes. At the present time the Kansu Red Deer is found in northern Shansi and thence probably westward into Kansu to the Tibetan border and southward into northern Szechwan. Records are not at hand for Shensi, while its presence in Szechwan and extreme northern Yunnan rests on none too secure proof. Excellent accounts of the general habits, habitat and pursuit of this deer are given by Sowerby (1914) for Shansi and by Wallace (1913) for Kansu. The former writes that the country preferred by these deer borders that over which wild sheep range, is rough and precipitous, with sparse birch woods in which they seek shelter. Certain forests and valleys are especially favored by them, probably because of the supplies of fresh water. The few small bands that are still to be found here "wander from one to another of these favoured spots over wide stretches of country. In winter the deer lie up during the night and for a couple of hours at noon, feeding in the morning and afternoon. During the warmer months they travel during the night and feed very early in the morning and late in the evening." The rutting season is in autumn and is over by the end of November, when the stags leave the does and go off in twos and threes. The herds, led by old hinds, gradually split up, until in May, when the fawns are born, the does may be seen in little companies of two or three like the bucks. The Chinese hunt the pregnant does at this season, for the unborn young are prized as "medicine," and the bucks in early summer are persecuted for their antlers for a similar use. At other times the hunters leave the deer more or less alone, but on the Tibetan borders they are sometimes harried by the Wild Dogs (*Cuon*) which will soon clear all the deer out of a locality. In Shansi native hunters resort to driving, but in Kansu still-hunting is pursued. In the former province this deer has been taken near Kweihwacheng and the Lingcheng River, in the northern part, and in Kansu near Taochow and in the Min Shan Range. Wallace writes that in the latter

province old hunters speak of a marked decrease in the numbers of Red Deer even in their own time. They are relentlessly hunted by the Chinese and by the Wild Dogs (*Cuon*). Their roar, says Wallace, "is quite different from the wonderful ringing bugle of the North American wapiti. . . . It resembles the sound made by a red deer, but is rather deeper in tone, and in the case of one or two stags I heard there was just a suspicion of 'bugling' at the end of the roar." They are "found in the Minshan Mountains over an area of about fifty by twenty-five miles. They do not extend to the north, east or west but are said to exist to the south beyond the mountains" in northern Szechwan.

Specimens examined.—The following five:

Shansi: Lingcheng River, 1; Kweihwacheng, 4.

493. *Cervus macneilli* Lydekker

M'NEILL'S DEER; WHITE STAG; "PEILU"

Cervus cashmirianus macneilli Lydekker, Proc. Zool. Soc. London, 1909, p. 590, pl. 69.

Cervus canadensis wardi Lydekker, Proc. Zool. Soc. London, for 1910, p. 987, fig. 143, 1911; Cat. Ungulate Mamm. Brit. Mus., vol. 4, p. 138, 1915. Szechwan border of Tibet.

Cervus macneilli Pocock, Proc. Zool. Soc. London, 1912, p. 571.

Cervus macneilli macneilli Lydekker, Cat. Ungulate Mamm. Brit. Mus., vol. 4, p. 145, 1915.

Type specimen.—The type is the mounted skin and its skull of a doe in the British Museum, No. 9.5.31.1, collected by Major M. M'Neill on the "Szechuan border of Tibet" about 1909.

Description.—The type, a female in summer pelage, is a large deer of the elaphine group, of a very pale general color, a finely speckled gray and brownish black. The lips and nose are pale drab, not contrastingly white as they are in the White-lipped Deer. The inner side of the legs is pure white, as is also a narrow rim on the inner margin of the buttocks. This latter area is bordered by a blackish stripe, with indistinctly defined boundary where it merges with the general body color, and this black stripe continues across from side to side dorsally to include the upper side of the tail.

The winter pelage, as represented by skins obtained by Mr. Brooke Dolan in eastern Tibet, is grayer with a brownish wash over the back, a narrow blackish spinal line, and the throat and sides of the neck a mixed gray and brown. It is thus even paler than in summer, and the white pygal area lining the buttocks is as narrow as in summer.

The antlers of the male are strictly of the elaphine type, with a large brow tine and a bez tine, well developed, hooking forward and a little downward, then turning slightly upward at the tip. When viewed from in front, the main beam of the antler spreads outward and upward, then at the level of the trez tine curves strongly inward to the tip. The trez tine comes off from the front face or the outer side of the beam, which again forks at a distance above the

trez about equal to the distance of the latter from the bez tine. The terminal forking varies in different individuals and even on opposite sides of the same animal. Thus in one case the summit consists of a long tine pointing forward and upward, and a posterior branch curving slightly inward and forking again near its tip. In another the "crown" consists of three long tines, subequal, arising from a common base, one behind the other in the same antero-posterior plane.

In immature males which still retain the milk molars, the antler may be a simple beam, unbranched, from a low pedicel, curving slightly outward, then curving regularly inward to its tip. In specimens examined, this simple beam may be from 295 to 365 mm. long on the outer curve. An adult antler in the collection of the Academy of Natural Sciences of Philadelphia measured: length of brow tine on the curve from burr to tip, 295 mm.; bez tine, 310; distance from base of bez to trez tine, 368; length of trez tine from outer base to its tip, 260; distance from trez tine to base of fourth tine, 355; anterior terminal tine, 295; posterior terminal tine, 350. In one specimen, the trez is very short; in another the main beam above the trez does not fork again and is about twice the length of the trez, curving regularly inward. The upper canine is well developed in both sexes.

Measurements:—The total length of a tanned skin, adult male, from tip of nose to tip of tail is about 1,800 mm. In a recent paper (Proc. Acad. Nat. Sci. Philadelphia, vol. 90, pp. 284-285, 1939), I have published cranial measurements of four males and four females of the series brought back from eastern Tibet by Brooke Dolan, and now in the collection of the Academy of Natural Sciences of Philadelphia. The dimensions of the largest male and the largest female there appear as follows: condylobasal length, male, 387 mm., female, 364 mm.; basal length, 357, 353; palatal length, 230, 224; length of nasals, 145, 147; combined greatest width of nasals, 54.7, 47; zygomatic width, 152, 144; width across orbits above, 130, 137; width across molars, 101.5, 101; upper cheek teeth, 119.5, 115; lower cheek teeth, 136, 125.

Nomenclature:—Until a more thorough study can be made of the elaphine deer of the Old World, especially those from Asia, it does not seem possible to make out the relationship of this deer to the other Himalayan deer, such as *Cervus affinis*, *C. wallichi*, and *C. cashmirianus*, but it is probably close. Here, however, it may be noticed that Lydekker in his original account compared it with the last-named, of which he considered it merely a race. Pocock, three years later, still with merely the original female specimen for study, pointed out its resemblance to the Kansu Red Deer in its color pattern, but retained it as a species distinct from that animal. Finally Lydekker, in his review of 1915, considers the Kansu Red Deer a race of M'Neill's Deer!

Now that Mr. Brooke Dolan has secured adult male specimens of M'Neill's Deer with the antlers, a comparison becomes possible between these and the pair of antlers which Lydekker in 1911 believed represented a new race of the wapiti, and named *Cervus canadensis wardi*. The two detached antlers are mounted on a single shield in the British Museum and are catalogued as No. 10.5.14.1 in that institution. They were collected by Rev. W. N. Fergusson, who selected them from a load of antlers being transported through western Szechwan near the Tibetan border, in 1910. A comparison of Lydekker's photographic figure leaves little doubt that they are those of M'Neill's Deer, so that the name becomes a synonym of *Cervus macneilli*. They show the same curving of the beam, first out and up, then in toward the tip; the same large, downward and upward curved brow and bez tines; the trez tine comes off about halfway on the curve; the terminal tines are three, with the anteriormost and posteriormost in about the same antero-posterior plane, with the third branching from the outer side at their base. These antlers are of nearly maximum size, with a chord from base of burr to tip of longest point, of 1,255 mm. for the right antler. Other measurements of the same antler, which I took when at the British Museum in 1934 are: length of brow tine on curve, 335 mm.; length of bez tine, 395; distance between bez tine and trez tine, 300; from trez tine to "cup," 410; length of uppermost anterior tine, 420; circumference at burr, 230.

Occurrence and Habits.—Since the description of this deer from a doe in 1909, nothing further was known of it until Mr. Brooke Dolan, on his expedition of 1934-36 to Szechwan and eastern Tibet, met with it and secured adults of both sexes including males with antlers. Some account of these I have already published, together with Mr. Dolan's brief notes. Sowerby (1936a) has also published some of Dolan's photographs of M'Neill's Deer in a general account of the expedition. The animal is apparently typical of the Tibetan plateau, and extends its range to the extreme western border of Szechwan, where it occurs "in the marginal forests of the Mekong, Yangtse and Yalung ranges, usually above 12,000 feet, in heavy growth of rhododendron. It is now very scarce in the vicinity of Litang, where the first specimen was taken by Captain M'Neill, and the expedition saw no evidence of it there except antlers and velvet shown to us by the merchants, and said to have come from deer killed in the vicinity, although they might well have come from far away. We collected them in March of 1935, two days west of Jyekundo. A stag observed had not yet shed its antlers. Schäfer [his companion] later collected others in the Mekong drainage southwest of Jyekundo, and in September found them most plentiful near the monastery of Dzogchen, not far from Derge on the Yalung watershed. The big stags were [then] about to shed their velvet, but the younger stags were in full velvet, with their antlers

still soft. The skins taken in September were in clean summer hair. These deer have been much persecuted by the natives for the aphrodisiac properties believed by the Chinese to be inherent in antler velvet. They were probably once plentiful over most of eastern Tibet. At the present time they are protected by the monastery at Dzogchen, and we heard in Jyekundo that native chieftains protect them to the west of that place" (B. Dolan, quoted in Proc. Acad. Nat. Sci. Philadelphia, vol. 90, p. 285, 1939).

Specimens examined:—In addition to the series of eight males and six females from eastern Tibet brought back by Dolan and presented by him to the Academy of Natural Sciences of Philadelphia, I have examined both the type of M'Neill's Deer, a skull and mounted skin in the British Museum, and the type antlers of *Cervus canadensis wardi* in the same museum.

Genus *Alces* Gray

ELK OR MOOSE

Alces Gray, London Medical Repository, vol. 15, p. 307, 1821. Miller, Cat. Mamm. Western Europe, p. 977, 1912. Lydekker, Cat. Ungulate Mamm. Brit. Mus., vol. 4, p. 228, 1915.
Paralces J. A. Allen, Bull. Amer. Mus. Nat. Hist., vol. 16, p. 160, 1902 (substitute for *Alces*, believed to be preoccupied by *Alce* Blumenbach).

The Elk or Moose is the largest of the deer now living, and belongs in the section Telemetacarpalia in which the distal ends of the lateral metacarpals are present, as in *Hydropotes*, *Capreolus* and the American *Odocoileus*. The shoulders are much higher than the rump, the neck relatively short, the tail a mere stump, the antlers, which are present in the males only, extending laterally, with a greater or less degree of palmation. The upper lips are ample, and form a muffle, with a narrow naked area from the border of the upper lip extending upward and laterally to the nostrils. The skull is long and tapering forward, with long, narrow premaxillaries. The large muffle is correlated with the shortened nasal bones. The vomer does not extend backward to divide the posterior nares. Canine teeth are normally absent from the upper maxillary, while the cheek teeth are as usual, three premolars and three molars, low-crowned and wide, with an exceedingly short accessory column of enamel at the inner edge, standing at the entrance to the valley between the two inner cusps, while in the lower jaw even smaller rudiments of a similar column occur at the outer edge of the first and second molars. The lower incisors have the crown nearly oval or spatulate, instead of produced to an angle at the outer tip. The young are not striped and spotted with white, but resemble the adults in their nearly uniform coloring.

Lydekker (1915) is doubtless right in regarding both the Old and the New World forms as races of a single species, the range of which is nearly coincident with the boreal forest belt from Scandinavia to eastern Siberia, and across

northern North America from Alaska to New England. The discrimination of local races is rendered difficult by the lack of series of skins and skulls from various parts of the range as well as by the variation in color with age and season. Although several supposed races of the European Moose have been described from a few individuals, the characters are subject to such variation that it is still uncertain how far these are constant enough to serve as a basis for separation of distinct subspecies. Lydekker (1915) in his "Catalogue of Ungulate Mammals" regards the eastern Siberian animal as the only subspecies recognizable in northern Asia. It barely enters the northern region of Mongolia, along with the Roe and some other boreal forest species.

494. *Alces alces cameloides* (Milne-Edwards)

MANCHURIAN ELK OR MOOSE

Cervus cameloides Milne-Edwards, Ann. des Sci. Nat., Zool., ser. 5, vol. 7, p. 377, 1867.

Cervus alces Milne-Edwards, Recherches pour servir à l'Hist. Nat. des Mammifères, p. 181, 1868-74.

?*Alces bedfordiæ* Lydekker, Proc. Zool. Soc. London, 1902, vol. 1, p. 109. "Siberia."

?*Alces machlis bedfordiæ* Lydekker, A Trip to Pilawin, p. 85, 1908; in Ward, Records of Big Game, ed. 6, p. 100, 1910; Rowland Ward's Records of Big Game, ed. 7, p. 100, 1914.

?*Alces pfizenmayeri* Zukowsky, Wild und Hund, vol. 16, p. 807, 1910. Northeastern Siberia.

?*Alces machlis yakutskensis* Millais, The Field (London), vol. 118, p. 113, 1911. Western Yakutsk.

?*Alces alces bedfordiæ* Lydekker, Cat. Ungulate Mamm. Brit. Mus., vol. 4, p. 234, 1915. G. M. Allen, Amer. Mus. Novitates, no. 430, p. 18, 1930.

Type specimen.—The type consists of one or perhaps more antlers brought by Fontanier from China, from a deer of large size which, according to information given him, was a native of Manchuria. Presumably the specimens described are in the Paris Museum.

Description.—The skin of an immature female secured by Dr. R. C. Andrews sixty miles northeast of Urga, Mongolia, is a mixed gray and brownish on the cheeks, neck and sides of the back, but the chest and flanks are clearer darker brown and the chin is blackish brown. The forehead and muzzle are tinged with ochraceous, and the feet and legs are similar but slightly darker, becoming brown near the hoofs. A short mane stands erect along the median line of the neck and shoulders and a very small (1 inch) "bell" or tuft is present at the throat. It appears paler than the moose of eastern North America. The Yakutsk Elk, according to Lydekker (1915), has the head and neck rich dark brown and "in some instances at any rate, dark brown shanks." The same author describes the color of the European Elk as "varying from yellowish grey to deep blackish brown, with the shanks whitish, the forehead dark chestnut, and the face below the eyes nearly black, but reddish grey near the muzzle. In winter the coat is darker than in summer . . . the colour gradually fading till the spring-change; it is only in animals of the second or third year that the winter coat attains its deepest sable, as it becomes gradually lighter each succeeding year, till in old males it is more or less grizzly."

The antlers, upon which the racial distinction has been mainly based, may or may not be palmate, apparently, depending, in part perhaps, upon abundant or sparse nourishment during the growing period in certain districts, and perhaps in part on whether or not the best-antlered specimens are eliminated by hunting over a period of time. In the non-palmate type the antlers grow out laterally, each as a stout beam which forks several inches from the short pedicel, forming a large anterior tine and a backward tine which continues as the main beam forking again, and the posterior branch of this fork once more subdividing. With more palmation the various branches divide into smaller and smaller points until the entire backward portion may be a wide "board" with the ultimate subdivisions of the tines appearing as points on its edges. This type apparently may also occur in the Siberian Moose.

The striking characters of the skull have already been mentioned.

Measurements:—No external measurements are available nor those of adult skulls. An adult male may stand from $5\frac{3}{4}$ to $6\frac{3}{4}$ feet at the shoulder. In a female, immature, from near Urga, Mongolia, the combined length of the three upper premolars was 66 mm.

The antlers tend to be less palmate than the average of European specimens, but are hardly different in size. "Rowland Ward's Records of Big Game" gives as the largest of four "Siberian" heads: greatest width, 49 inches; length to longest tine, 38.5 inches; tip to tip, 34.5 inches. These measurements are almost the same as for the largest Scandinavian head, which is of equal width, though 6.5 inches shorter to the tip of the longest tine. Evidently the difference is not great.

Nomenclature:—In a brief paragraph concluding the first part of his "Observations" on mammals from North China, Milne-Edwards (1867) briefly characterizes some antlers brought back by Fontanier, which, though procured in China, came originally, as he was informed, from Manchuria. These, writes Milne-Edwards, somewhat recall those of a young elk (or moose) but appeared to be from adult animals; they were but slightly elevated, and remarkably heavy; the short beam carried an anterior basal tine, which in adults is almost as stout as the main branch and is bifurcate. The palms are very broad, especially in youth. The main beam turns abruptly backward and gives off a second nearly vertical tine. Since the specimen before him appeared to be from an animal already old, the number of branches could hardly be more. This description undoubtedly applies to an elk (that is, moose) and the specimen perhaps furnished in part the basis for Milne-Edwards's later statement that "*Cervus alces*" occurs in the northern parts of China. He does not, however, again refer to his new animal, which it seems is appropriately called by the Chinese "cerf-chameau" (Camel Deer), doubtless referring to the hump. The

name, however, is apparently the first to be applied to an eastern Asiatic moose and the description very well defines the simple and slightly palmated antlers of the Asiatic race; it seems to have been overlooked by later writers.

In 1902 Lydekker concluded that the European Elk ranged with but little change eastward well across Asia, and named as a new race the Siberian Elk, *Alces bedfordiae*, on the basis of its non-palmate antlers. This name is possibly synonymous with *A. a. cameloides*, as perhaps also are the names *A. pfizenmayeri* Zukowsky and *A. machlis yakutskensis* Millais, but this determination must await a more thorough study of the northeastern elk.

In view of the considerable variations shown in cranial characters as well as in color by these large mammals, it seems questionable how far it is feasible to subdivide them into local races on the basis of few specimens. Zukowsky, however, believes that the Elk of Europe ranges unchanged as far across Asia as the region south of Lake Baikal and that those to the north are much darker. This may be a matter of age, and in any case it is probable that the differences between western Elk and those of Mongolia are very slight indeed.

Occurrence and Habits.—The Elk is a species of the boreal evergreen and mixed hardwood forests, with a more or less continuous range across northern Europe and Asia to eastern Siberia. It seems to be absent, however, from the region of the lower Amur River to the eastward of the Bureja Mountains. In former days it very likely was found as far south in eastern China as the northern parts of Hopei, for Milne-Edwards (1868-74, p. 181) writes that, according to notes sent him by Père Armand David, the Elk was said to be found in the northern part of China. There appears to be no recent record of its presence there, however, while the nearest that it comes to Hopei at the present time is possibly northern Manchuria in the province of Hilung Kiang (Sowerby, 1923g). Radde writing in 1862 traced its occurrence in southern Siberia along the borders of Mongolia from the middle Oka River, west of Lake Baikal, skipping the Syansk basin, to the Baikal and Apple Mountains, and east to the broad valleys of the Onon River and the lakes of this region as far at least as Tarei Nor in Transbaikalia on the Mongolian border. In the autumn of 1851, he writes, six Elk coming from the northwest appeared at the latter locality, mingling with a herd of domestic cattle, much to the surprise of the natives, to whom this deer was unfamiliar. Evidently it ranges south in Transbaikalia across the Mongolian border to within some sixty miles of Urga, where Dr. R. C. Andrews in August, 1919, secured an immature female. This is nearly the southern limit also of various other northern species associated with the larch and birch forests which here dwindle away at the edge of the Gobi.

Little information has been published as to the habits of the Elk in the

eastern part of its Asiatic range. No doubt, however, as elsewhere, it haunts well-wooded and well-watered country, feeding in summer along the edges of lakes and streams, and in winter retiring to sheltered valleys. The bulls are more or less solitary except during the rutting season in September and October, while at other times the females and young animals may gather into small bands. Two calves are often born at a time, though sometimes only one, in early summer.

Specimens examined:—One, from sixty miles northeast of Urga, Mongolia.

Family BOVIDÆ

ANTELOPES, GOATS, SHEEP, CATTLE

Members of the Bovidae are typically grazing animals of plains or mountainous country, less often of forests, and include many diverse types. As a feature in common, the males and frequently the females have true horns, which are permanent outgrowths of the frontal bones covered with a sheath of hardened skin, and, if the American Antilocapridæ be excepted as worthy of family distinction, are not shed nor are they branched, although their form is very varied. The incisor teeth, as in the Cervidæ, are lacking in the upper jaw, but in addition the upper canines are never present, while the cheek teeth are usually hypsodont, or with high crowns, in correlation with their grazing habits. The lower incisors are always six, the central ones with their outer corner angular, while the lower canines are, as in the Cervidæ, incisiform and lie against the third incisors. The lower cheek teeth are narrow, high-crowned, and the last has an additional terminal lobe; in other respects they much resemble those of the deer, and consist of three premolars and three molars, giving thus the formula: $i.\frac{0}{3} \ c.\frac{0}{1} \ pm.\frac{3}{3} \ m.\frac{3}{3} = 32$. The lachrymal bone usually is complete without a vacuity between it and the nasal or the frontal. The lateral toes may be absent, but are usually represented by small hoofs ("dew claws") with traces of the phalangeal bones, although the distal ends of the metapodials are not present. The gall bladder is characteristically present. The placenta is cotyledonous as in the Cervidæ, but with usually many more cotyledons. The family is characteristic of the Old World except Australia, with a few North American species, mostly of relatively late arrival. Four chief types may be recognized among the living species: the lightly built antelopes, more common in open plains or desert country; the goat-antelopes, represented by a few stocky species of rough mountainous country, serving in some respects to bridge the gap between the antelopes and the third section, the goats and sheep, which are again species of mountain areas; and finally the fourth type which includes cattle, heavier in body, and for the most part of temperate and tropical distribution. All four of these groups are represented

in China and Mongolia. Special interest attaches to the second, of which the Goral, Serow, and Takin are examples, and which are found chiefly in China, particularly in the western highlands, and extend slightly beyond its borders into the eastern Himalayas and, in the case of the Serow, into southeastern Asia as well. These are perhaps to be regarded as annectant forms that have long persisted in this part of Asia, and serve to indicate the transition from the stockier goat-like to the lighter antelope modification.

The following key will serve for the identification of the living genera occurring in China and Mongolia.

KEY TO GENERA OF CHINESE AND MONGOLIAN BOVIDÆ

- A. Lightly built, slender-limbed cursorial species, with narrow pointed hoofs, females without horns. Antilopine section
 - a. Tail short, less than 110 mm., nasals pointed anteriorly.
 - a'. Inguinal and carpal glands wanting.
 - a''. Preorbital glands present. *Prodocas*
 - b''. Preorbital glands absent. *Procapra*
 - b. Tail longer, more than 120 mm., nasals wide and notched in front. *Gazella*
- B. Form heavier, limbs stout, hoofs wide or bluntly pointed.
 - a. Horns present and of practically the same size in both sexes.
 - a'. Horns with narrow transverse rings, and arising close together at the summit of the skull at a point slightly more than halfway on its length. Rupicaprine section
 - a''. Horns shorter than head, directed backward in plane of forehead and slightly decurved.
 - 1. Cranial axis only slightly bent at the palate, lachrymal deeply pitted and in contact with frontal and nasal bones, preorbital gland large. *Capricornis*
 - 2. Cranial axis much bent at the palate, lachrymal smooth, and separated by a vacuity from frontal and nasal bones, preorbital gland very small. *Nemorhedus*
 - b''. Horns measured on front curve longer than head, directed upward, then outward and backward. *Budorcas*
 - b'. Horns smooth, widely separated, arising from a transverse ridge at the extreme vertex of the skull. Bovine section
 - 1. A heavy fringe of long hair from lower throat to buttocks, tail reaching to hock. *Poëphagus*
 - b. Horns much larger in the male than the female, spreading laterally or curving widely back and down. Caprine section
 - a'. Horns with narrow, transverse ridges, those of the male forming a lateral spiral; lachrymal bone with a shallow pit for the preorbital gland. *Ovis*

KEY TO GENERA OF CHINESE AND MONGOLIAN BOVIDÆ (Cont'd)

- b'. Horns not forming a lateral spiral; lachrymal bone without a pit, preorbital gland absent.
- a''. No black spinal stripe, chin not tufted; horns with a slight keel on the inner border, directed up, then out and slightly back. *Pseudois*
- b''. A black spinal stripe present, chin tufted; horns with spaced transverse knobs, their course a sweeping curve, evenly up, outward and down. *Capra*

Genus *Prodorcas* Pocock

- Prodorcas* Pocock, Ann. Mag. Nat. Hist., ser. 9, vol. 2, p. 130, 1918.
Antilope Pallas, Spicilegia Zool., pt. 12, p. 46, pl. 2, 1777 (in part); and later authors.
Cerophorus Blainville, Bull. Soc. Philom. Paris, ser. 3, vol. 3, pp. 74, 75, 1816 (in part).
Cemas Oken, Lehrbuch d. Naturgesch., vol. 3, pt. 2, p. 736, 1816 (in part).
Gazella Gray, Ann. Mag. Nat. Hist., ser. 1, vol. 18, p. 231, 1846; and later authors (in part).
Procapra Gray, Proc. Zool. Soc. London, for 1850, p. 115, 1867. Pocock, Proc. Zool. Soc. London, 1910, p. 892.
Hollister, Smithsonian Misc. Coll., vol. 60, no. 19, p. 1, 1913 (in part).

The type and only species of this genus is the *Antilope gutturosa* of Pallas, an aberrant gazelle, which resembles *Procapra* in the relatively short tail and the narrow pointed nasal bones, as well as in the type of coloring without the "gazelle" markings, or facial stripes on the head and without lateral stripes. On the other hand it differs from that genus and agrees with *Gazella* in possessing preorbital glands, although these are small, as well as in having inguinal and carpal glands. The structure of the pedal glands is unknown (Pocock, 1918). A unique character is, further, the presence of a preputial gland recalling in its position that of the Musk Deer and the Pig. On account of this combination of characters, Pocock has proposed for this gazelle the genus *Prodorcas*, in which perhaps the pointed nasals and the preorbital and preputial glands may be looked upon as primitive traits. It is confined to North China and Mongolia chiefly, but extends into southern Transbaikalia and formerly, at least, reached the lower Amur region. Two races are currently recognized, one of doubtful value. These are distinguished as follows:

KEY TO MONGOLIAN RACES OF *Prodorcas*

- A. Horns of the males less divergent, about 135 mm. or less between tips; eastern. *P. gutturosa gutturosa*
- B. Horns of males more divergent, about 180 mm. between tips; western. *P. gutturosa altaica*

495. *Prodorcas gutturosa gutturosa* (Pallas)

MONGOLIAN GAZELLE; "ZEREN"

- Antilope gutturosa* Pallas, Spicilegia Zool., pt. 12, p. 46, pl. 2, 1777.
Antilope orientalis Erxleben, Syst. Regni Animalis, Mammalia, p. 288, 1777.
Cerophorus (Antilope) gutturosa Blainville, Bull. Soc. Philom. Paris, ser. 3, vol. 3, p. 75, 1816.

- Cemas gutturosa* Oken, Lehrbuch d. Naturgesch., vol. 3, pt. 2, p. 736, 1816.
Antilope tzeiran Zimmerman, Specimen Zool. Geogr., p. 543, 1817.
Gazella gutturosa Gray, Ann. Mag. Nat. Hist., ser. 1, vol. 18, p. 231, 1846.
Procapra gutturosa Gray, Proc. Zool. Soc. London, for 1850, p. 115, 1851. Pocock, Proc. Zool. Soc. London, 1910, p. 892.
Gazella gutturosa mongolica Rhoads, Proc. Acad. Nat. Sci. Philadelphia, 1898, p. 124.
Gazella (Procapra) gutturosa Lydekker, Rowland Ward's Records of Big Game, ed. 7, p. 241, 1914; Cat. Ungulate Mamm. Brit. Mus., vol. 3, p. 34, 1914.
Prodorcas gutturosa Pocock, Ann. Mag. Nat. Hist., ser. 9, vol. 2, p. 130, 1918.

Type specimen.—None known to be in existence. Pallas met with this species on the upper Onon River in southern Transbaikalia, so that this region close to the Mongolian border may be taken as the type locality.

Description.—Size considerably larger and build more stocky than in the small Tibetan Gazelle. General color above in summer bright ochraceous buff, paling on the cheeks, flanks and haunches to pinkish cinnamon; muzzle brown above; legs ochraceous buff in front, becoming brownish on lower half or third; chin and upper throat, belly and inside of limbs white, extending up on the buttocks on either side of the base of the tail, forming a small pygal disk which is interrupted medially by a narrow line continuing the color of the back to the brown of the very short stumpy tail. Ears shorter than in the Goitred Gazelle, short-haired, colored externally like the back, but white inside. Tail darker brown than the back, whitish at the sides. In comparison with the Goitred Gazelle (*Gazella subgutturosa hillieriana*), the color is much richer, more golden, instead of pale sandy.

In winter coat the color is paler, more pinkish buff, and the hair longer with scattered long white hairs on the sides; the white area of the pygal patch is more sharply defined, and the haunches paler, almost white with a pinkish tinge.

The skull is remarkably light of bone and in profile has a marked upward convexity where the nasals and the frontals meet, with another ridge-like convexity medially at the level of the posterior orbital border. In *Gazella* the rostrum is flat above and the orbits rise above the median ridge. In addition, the skull of *Prodorcas* has smaller audital bullæ, a longer rostrum, and narrow pointed nasals which in *Gazella* are shorter, broader and notched terminally. The orbit is smaller and the teeth longer.

The horns are less spreading than in the Tibetan Gazelle, rather short and lightly ridged in a transverse direction. Arising from the summit of the frontals, they diverge slightly at first, then more widely before turning inward at the tips. There is very little downward curvature.

Measurements.—The Mongolian Gazelle is rather larger than other Chinese and Mongolian species, standing "fully 30 inches" (765 mm.) high at

the shoulder. The tail is longer than in *Procapra*, about $2\frac{3}{4}$ inches (70 mm.), but much shorter than in *Gazella s. hillieriana*, according to Lydekker, but in the following series of measurements made (in inches and here reduced to millimeters) by Dr. Andrews, it appears to be longer than Lydekker's measurement.

The following flesh measurements accompany Dr. Andrews's specimens:

No.	Head and body	Tail	Hind foot	Ear	Sex	Locality
46448	1270	108	368	114	♂	Mongolia
46444	1210	89	343	108	♀	Mongolia
46446	1143	114	343	102	♀	Mongolia
46449	1041	102	330	102	♀	Mongolia
46452	1041	89	318	102	♀	Mongolia
46453	1136	102	318	198	♀	Mongolia

Males are slightly larger than females.

CRANIAL MEASUREMENTS OF *PRODORCAS GUTTUROSA*

No.	Great- est length	Basal length	Pala- tal length	Orbit to tip of ros- trum	Zygo- matic width	Mas- toid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Sex	Locality
<i>P. gutturosa gutturosa</i>											
85235	261	256	130	147	99.0	71.5	67.6	73.0	76.6	♂	Mongolia
46400A	247	234	111	135	98.5	68.0	69.0	71.9	77.3	♂	Mongolia
46444	242	221	123	133	91.0	69.0	68.0	71.5	74.5	♀	Mongolia
46446	240	216	123	141	87.5	63.0	62.5	72.0	76.0	♀	Mongolia
46453	240	221	124	139	90.0	67.0	64.0	68.0	70.0	♀	Mongolia
46457	234	215	120	135	92.5	63.0	70.0	70.0	72.5	♀	Mongolia
46459	237	216	121	133	86.5	64.0	59.0	73.0	75.0	♀	Mongolia
46469	247	225	125	138	92.0	64.5	63.0	75.0	80.0	♀	Mongolia
46475	242	222	130	141	87.5	66.0	64.0	68.0	72.0	♀	Mongolia
46476	242	219	124	140	86.5	67.0	62.0	71.8	75.5	♀	Mongolia
57282	233	226	118	133	86.0	64.5	65.0	67.0	72.0	♀	Mongolia
46470	240	218	122	140	92.0	68.0	71.0	65.0	72.0	♀	Mongolia
<i>P. gutturosa altaica</i>											
175179 USNM (type)	260	237	—	146	113.0	—	—	70.0	72.0	♂	Mongolia

The horns of adult males are said to measure from 13 up to $15\frac{3}{4}$ inches (330-399 mm.) in length (Lydekker, 1914). No. 85235 has a horn length, following curves, of 245 mm., and a tip to tip distance of 175 mm.

Occurrence and Habits.—In Pallas's time, a century and a half ago, this gazelle extended its range as far eastward as the shores of the Pacific Ocean in the Amur region, but at the present day, according to Pousargues (1898b),

is no longer found in that area nor in Manchuria, but reaches its eastern limit in the Khingan Mountains at the eastern end of Mongolia. It abounded on the plains between the Onon and Kerulen Rivers, but became rare in the Selenga basin and did not pass northward of the Syansk Mountains in southern Siberia. To the westward it occurs across northern Mongolia in the grasslands to the Altai region, merging no doubt with the Altai race, if that is really distinguishable. In winter there was some evidence that it migrated southward a short distance from the northerly portion of this range, doubtless in search of

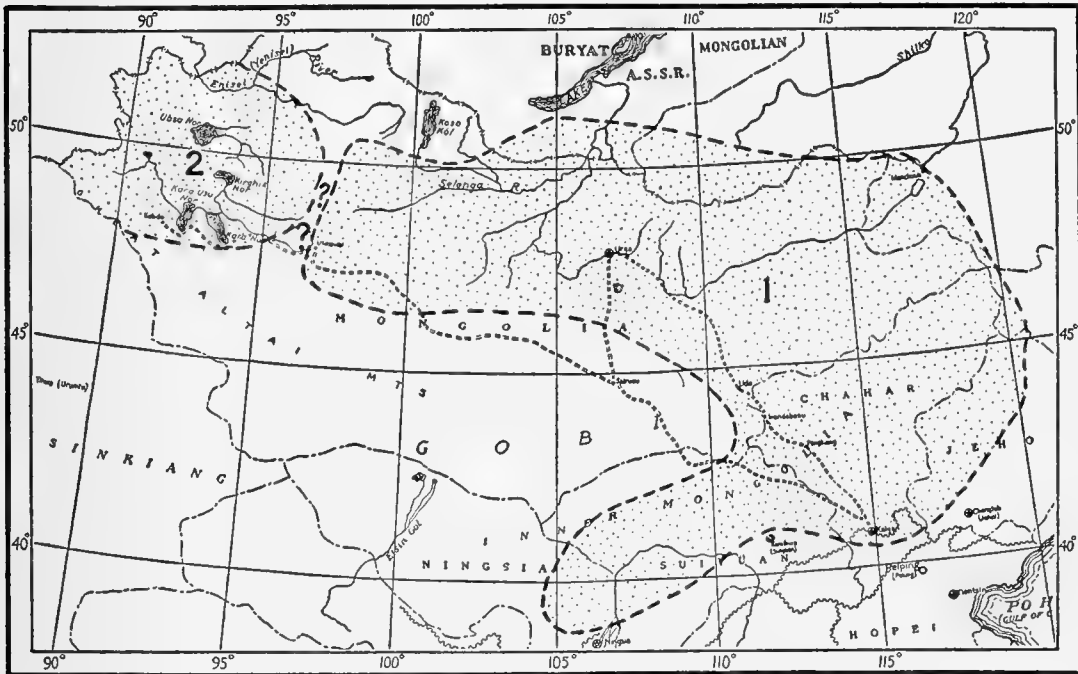


FIG. 68. Distribution Map.

*Prodocas*1. *P. gutturosa gutturosa*2. *P. gutturosa altaica*

pasturage, the animals moving into the country about Tarei Nor and Dalai Nor, and as far south as Kalgan. Rhoads (1898) mentions specimens from the Imperial Hunting Park, northeast of Dolon Nor, one of which, a female, contained a nearly mature fetus on June 6. It is a characteristic and abundant animal of the great grassy plains of northern Mongolia, in contrast to the Goitred Gazelle, which is a more desert-loving species and is typical of the barren deserts of the Gobi to the south and west of the grasslands, although at times both animals are found together. This distinction in habits and habitat was found by Dr. R. C. Andrews to be frequently very sharp, so that in passing from Uskuk ten miles south to Loh, this species was abundant at first, but

within the space of a mile after descending from the grassy plain to the desert no more were seen, but *Gazella subgutturosa hillieriana* became numerous. In crossing from Kalgan to Urga, it was abundant on the Pangkiang plain, about Ude and on the Tuerin plain, sometimes in company with the latter species, but at this time in early June they were shedding the winter pelage badly and no specimens were preserved. Later, however, a series was secured at distances of one hundred and forty, one hundred and twenty, and eighty miles southeast of Urga. Dr. Andrews found it abundant at Tsetsen Wang but saw none in the Tola valley. At Ongin River he noted a few, and a larger number between there and Sainnoin Khan. "Bucks were with the does on June 1st." Near the latter locality, great numbers were encountered "apparently working northward" toward better pasturage. Females killed June 17 contained fetuses. Dr. Andrews found them at this time in enormous herds numbering from 6,000-8,000, traveling slowly toward the flat plains where the young are born, and where the level nature of the country makes it impossible for wolves to approach without being seen. On reaching these plains the herds break up, the young are born and within a few days are able to run well, making a speed when pushed of twenty-five miles an hour for several miles. During the time when the young are being brought forth, the adult males separate from the does, and the sexes do not again associate together until the rutting season in late fall. This spring migration is described vividly by Dr. Andrews (1926) as witnessed by him and his party some three hundred miles northwest of Kalgan. He writes: "We discovered them one morning six miles from camp streaming up out of a great basin. Thousands upon thousands of bucks, does and fawns poured in a yellow flood over the rim and spread out like a vast fan upon the plain. . . . A mile away the squalling of the babies reached us. With the glasses we could see them nursing and playing. . . . Sometimes a thousand or so would dash at full speed through the centre of the herd, only to stop abruptly and begin to feed. The mass was in constant motion; hardly for a moment was any part of it stationary although the animals were entirely at peace. I was surprised not to see a single wolf. . . . Just before the young are born the females collect on a flat plain and separate as they drop their babies. In the fall the bucks, does and fawns again assemble." Presumably the bucks mentioned in the case of the herd just described were immature animals.

These gazelle were found by Swinhoe in 1870 north of Peiping, and by F. W. Styan about 1900; M. P. Anderson secured specimens for the British Museum thirty miles north of Lanchow, Kansu. This is the species to which the name "hwang-yang" (Yellow Sheep) chiefly applies. In the time of which Du Halde (1738) wrote, the "yellow goats" were a favorite object of pursuit by the Chinese emperor, who caused his hunters to round up bands of them, of which he would kill fifty or more in a day with bow and arrow.

Specimens examined:—The following thirty-five:

Mongolia: Kalgan to Urga, 1; twenty miles southeast of Urga, 1; eighty miles southeast of Urga, 6; one hundred and twenty miles southeast of Urga, 4; one hundred and forty miles southeast of Urga, 7; Hurumtu, 2; Shara Murun, 1; Tsagan Nor, 1; no exact locality, 12.

496. *Prodorcas gutturosa altaica* (Hollister)

ALTAI GAZELLE

Procapra altaica Hollister, Smithsonian Misc. Coll., vol. 60, no. 19, p. 1, 1913; Proc. U. S. Nat. Mus., vol. 45, p. 531, pls. 41, 42, 1913.

Gazella (Procapra) gutturosa altaica Lydekker, Cat. Ungulate Mamm. Brit. Mus., vol. 3, p. 39, 1914.

Type specimen:—An adult male, skin and skull, No. 175179, U. S. National Museum, from Suok Plains, near south end of Bain Chagan Pass, Little Altai, Mongolia. Collected July 5, 1912, by Theodore Lyman.

Description:—Similar to the typical race but with the colored area of the back more extensive, the skull broader, molar teeth larger, and horns much more spreading. The type, in summer coat, is described as having the upper parts and sides ochraceous buff, the face from the nostrils to between the eyes drab, sharply cut off from the buff of the sides of the muzzle and head, which blends into the white of the chin and upper throat. Ears scantily haired and light buff. The small rump-patch is sharply marked by the brown spot on the spike-like tail. Outside of the legs, light buff with a shading of drab near the hoofs. Under side of neck buff. Under side of body and inside of fore legs white, sharply marked off.

Compared with the eastern Mongolian Gazelle, the type of *P. g. altaica* is said to have a heavier skull, which is broader across the middle of the maxillary region. The teeth are said to be larger, the upper row shorter but the molars considerably wider, the last upper molar having the width of the posterior column 11.5 mm. against 9.4 or less, while the last lower molar has its posterior lobe "not directly in line with interior cusps of molar row, as in *gutturosa*, but forming a column-loop in line with the outer semi-circular lobes of molar row, thus giving m_3 three approximately equal outer semi-circular lobes." The horns are said to be much more spreading than in the eastern animal, with a distance between the tips of 180 mm., against 102-135 mm. in the latter.

While it seems uncertain how far the characters claimed for the form of this gazelle inhabiting the extreme west of the species' range will hold good, it is provisionally admitted on the strength of Hollister's description, and Lydekker writes of an Altai specimen in the British Museum that the skin in its color pattern "agrees very closely with that of the type, and the 'spike-like' tail shows the same brown dorsal spot." On the other hand the shape of the

terminal lobe of the last lower molar is found to be variable in the skulls from near Urga that I examined, for in some it is very narrow with its long axis in line with that of the inner cusps, but in others, especially with age and wear, it becomes wider transversely and its axis slightly deflected outward. There seems to be little doubt that the tooth characters relied on in describing the type specimen are after all subject to much individual variation while the width of the teeth changes somewhat in age, according to the angle of wear. The distinction then comes chiefly in the more divergent horn tips.

Measurements:—Hollister gives the following measurements of the type skin as made up: head and body, 1,325 mm.; tail, 12; ear from notch, 97.

Skull of the type: greatest length, 260 mm.; condylobasal length, 250; basal length, 237; greatest breadth, 113; breadth of rostrum above second molar, 79; length of nasals, 93; breadth of opening of anterior nares, 43.5; orbit to end of premaxillæ, 146; upper tooth row, crowns, 70; lower tooth row, crowns, 72; length of horn core over curve, 270; distance between horn tips, 180.

Occurrence and Habits:—The type locality, Suok Plains, seems to be just within the extreme western boundary of Mongolia in the Little Altai region. How far the range may extend to the westward cannot yet be stated, but probably not very far. To the eastward intergradation presumably takes place with the eastern Mongolian race. In his account of the mammals obtained in the Altai of extreme western Mongolia and the adjacent parts of Siberia, Hollister (1913c) mentions that, though formerly abundant on the Chuisaya steppe, they were then no longer so, and only a few small bands of four, five or six were seen, and these were very shy.

Specimens examined:—None.

Genus *Procapra* Hodgson

Procapra Hodgson, Journ. Asiatic Soc. Bengal, vol. 15, p. 334, 1846. Pocock, Ann. Mag. Nat. Hist., ser. 9, vol. 2, p. 131, 1918.

Antelope Wagner, in Schreber, Säugthiere, Suppl., vol. 5, p. 408, 1855 (in part).

Gazella Brooke, Proc. Zool. Soc. London, 1873, p. 547. P. L. Sclater and Thomas, Book of Antelopes, pt. 10, p. 71, 1898.

The genus *Procapra* was founded by Hodgson for the species *P. picticaudata*, which differs from the typical gazelles in its dark gray color, lack of facial markings, and absence of a side stripe. The tail is very short, horns are present in the male only and are of rather more graceful shape than in other gazelles, curving upward, then backward, with the tips slightly upturned again and sometimes turned in a very little, forming a somewhat sigmoid curve. Authors have usually followed Sir Victor Brooke in making this a synonym of *Gazella*, to which it is undoubtedly closely allied, but Pocock (1918) very

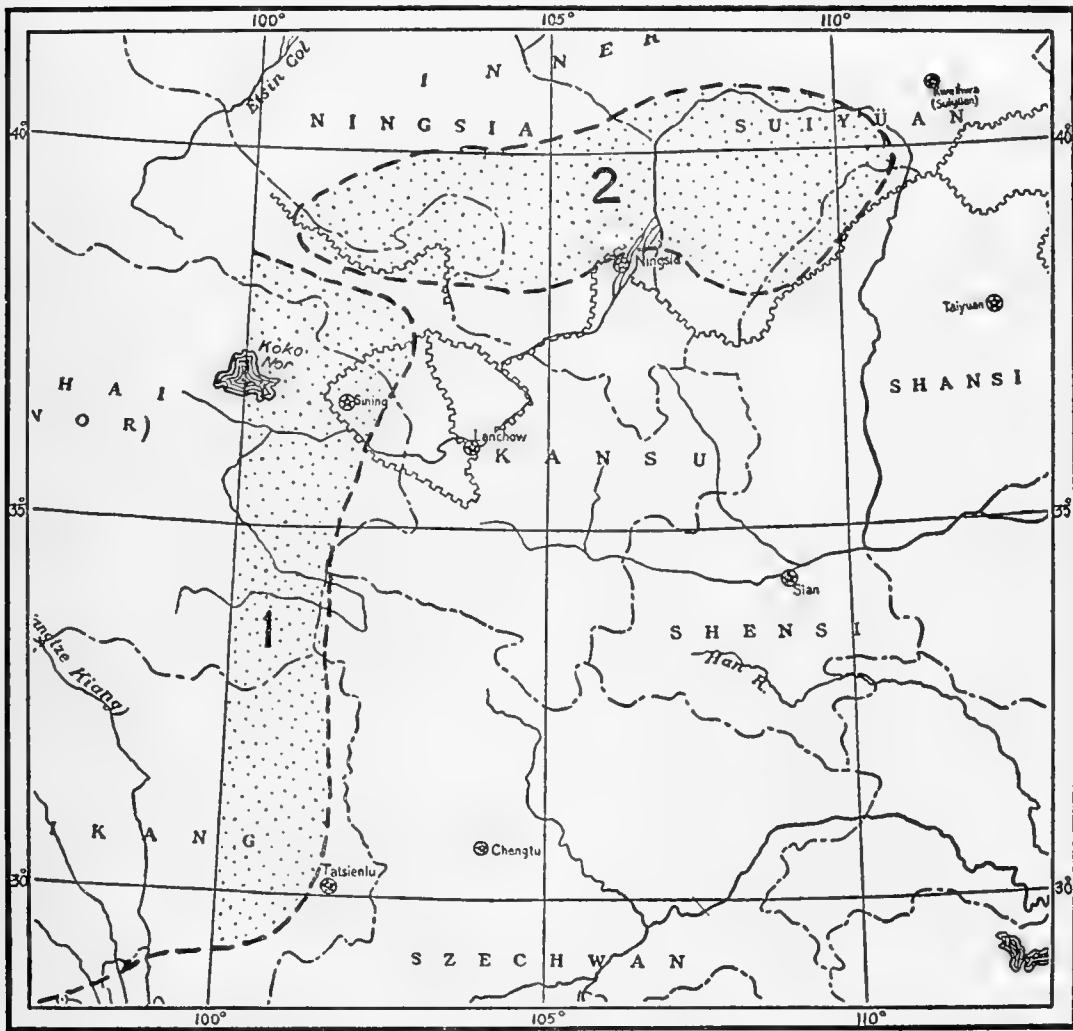


FIG. 69. Distribution Map.

*Procopra*1. *P. picticaudata picticaudata*2. *P. picticaudata przewalskii*

properly emphasizes its peculiar lack of preorbital, inguinal, and carpal glands, the presence of a gland behind the horns in the male, the reduced size of the pedal glands which appear to have a pore-like opening as in *Ovis* and *Nemorhedus*, and the different appearance of the rhinarium, which is covered with hair except for a very narrow vertical line from lip to nostrils, so that altogether these differences seem sufficient to place it in a distinct genus. The slender limbs, narrow hoofs, and lightly built body are characters in common with other gazelles. The single species is characteristic of the eastern Tibetan plateau and just reaches the western border of Chinese territory.

A second species has been described from the extreme northeast corner of Tibet and northwestern China, the so-called Przewalski's Gazelle. The characters claimed for it are so slight, however, that it can be at most only a subspecies of *Procapra picticaudata*, though Pousargues has suggested the possibility of its being a hybrid between the latter and *Gazella subgutturosa*. The following key may distinguish the two races.

KEY TO CHINESE AND MONGOLIAN RACES OF *Procapra*

- A. Tips of the horns directed nearly backward in same direction
as the main shaft. *P. picticaudata picticaudata*
B. Tips of the horns strongly hooked in. *P. picticaudata przewalskii*

497. *Procapra picticaudata picticaudata* Hodgson

TIBETAN GAZELLE; "GOA"

Procapra picticaudata Hodgson, Journ. Asiatic Soc. Bengal, vol. 15, p. 334, pl. 2, 1845; *ibid.*, vol. 16, p. 696, 1847. Pocock, Ann. Mag. Nat. Hist., ser. 9, vol. 2, p. 131, 1918.

Antelope picticaudata Wagner, in Schreber, Säugthiere, Suppl., vol. 5, p. 408, 1855. Przewalski, Mongolia (English translation by Morgan), vol. 2, p. 208, 1876.

Gazella picticaudata Brooke, Proc. Zool. Soc. London, 1873, p. 547. P. L. Sclater and Thomas, Book of Antelopes, pt. 10, p. 71, pl. 52, 1898.

Type specimens.—A male skull, with horns, No. 48.6.11.19, British Museum, from the Hundes district of Tibet, presented by B. H. Hodgson. Two other skulls from the same source are listed in the "Catalogue of Ungulate Mammals in the British Museum," one of which is figured by Hodgson in the original description. Probably the first-mentioned skull is to be considered the lectotype, and both are really cotypes.

Description.—A small slender species, standing about 24-25 inches at the shoulder (Lydekker). General color of the head and neck and the upper parts of the body a uniform brownish gray, about "burnt umber," becoming paler on the legs to buffy gray, and slightly rusty about the edges of the pure white pygal patch. Belly and inner sides of the legs white. Many of the hairs of the upper side have a minute grayish tip, giving a faintly grizzled effect on close inspection. Winter skins are described as "pale fawn, darkening posteriorly" (Lydekker). There are no dark facial markings nor lateral stripe, resulting in an unusually even tone to the pelage. The short tail is clothed with mixed black and rusty hairs which continue in the median line across the white rump-patch.

The hoofs are narrow and delicate, the lateral ones of both fore and hind feet much compressed and well developed.

The skull is lightly built, with very prominent, almost tubular orbits, the distance from their rim to the brain case being equal to a third of the distance across the frontoparietal suture. The lachrymal bone is long and narrow, its

posterior border forming the anterior rim of the orbit. This bone ends anteriorly in a nearly squared edge, with a slightly emarginate ventral border. It is broadly in contact with the anterolateral border of the frontal, but is separated from the posterior border of the nasal by a vacuity, anterior to which the dorsal edge of the maxillary and the upper end of the premaxillary are in contact with the middle third of the nasal. There is no pit in the lachrymal, a condition correlated with the lack of a preorbital gland, but the surface of the bone is gently concave. The nasals are flat, their combined edge irregularly transverse posteriorly, while in front they taper to a blunt median point. The teeth are small and narrow, the upper premolars with the posterior corner strengthened to form a projecting column, which is present also at the anterior corner of the second and third premolars. The upper molars have similar anterior and middle ridges. The tooth rows converge gently forward.

The horns of the male diverge slightly backward, their basal two-thirds forming a regularly curving arc, their distal third bending upward. All but the terminal 50 mm. or so is marked with heavy transverse ridges.

Measurements.—No external measurements are available from Chinese specimens. "Rowland Ward's Records of Big Game" gives $14\frac{1}{8}$ inches (361 mm.) for the longest horn, measured on the front curve, for Ladak specimens; one from Zanzskar, Szechwan, measured 300 mm. (M.C.Z.). The weight is given in "Rowland Ward's Records" as about 45 pounds.

Two skulls from the latter locality, slightly damaged at the occipital region, measure as follows:

CRANIAL MEASUREMENTS OF *PROCAPRA PICTICAUDATA*

No.	Great- est length	Pala- tal length	Zygo- matic width	Mas- toid width	Orbit to tip of rostrum	Width across molars	Upper cheek teeth	Lower cheek teeth	Sex	Locality
29953 MCZ	(185)	108	89	(57)	105	49	55.5	58	♂	Szechwan
29954 MCZ	(175)	91	81	(51)	95	46	59.0	59	♀	Szechwan

Occurrence and Habits.—This is another of those species characteristic of the semibarren Tibetan plateau, extending its range eastward to the extreme western border of China where the plateau country merges with the mountains of the Chinese highlands. Lydekker (1914, p. 31) states the general range as extending "from the high ranges of Spiti and the Changchenmo district of Ladak through the Tibetan plateau to Kan-su, Shen-si, and the Tatung-gol Valley, a tributary of the Hoang-ho, to the north of Koko Nor." The inclusion of Shensi in the range is, however, probably a mistake, for there seem to be no certain records of the species to the northeast of Tatung Gol on the northwest border of Kansu. In northwestern Szechwan Mr. Brooke Dolan in 1931 secured for the Museum of Comparative Zoölogy and the Academy of

Natural Sciences of Philadelphia a small series taken fifty miles west of Sungpan at a locality called Zanzskar. It also occurs farther south in the province to within a short distance of Tatsienlu, in the outposts of the Tibetan grasslands, "as far south as four days below Batang and an undetermined distance south of Litang."

Of its hunting, Sclater and Thomas ("Book of Antelopes," part 10, 1898) have given a brief account and mention the difficulty of seeing it, so closely does its color blend with that of the landscape. It is gregarious, traveling in small bands.

Specimens examined:—Three, from Zanzskar, northwestern Szechwan (M.C.Z.).

498. *Procapra picticaudata przewalskii* (Buechner)

PRZEWALSKI'S GAZELLE

Gazella przewalskii Buechner, Bull. Acad. Imp. Sci. St. Pétersbourg, vol. 34 (new ser., vol. 2), p. 115 (Mélanges Biol., vol. 13, p. 161), 1892. P. L. Sclater and O. Thomas, Book of Antelopes, pt. 10, p. 79, pl. 53, 1898.

Antelope gutturosa Przewalski, Mongolia (Russian ed.), vol. 1, p. 18, pl. 1, fig. 1, 1875; Mongolia (English translation by Morgan), pp. 20, 28, 1876; Reisen in Tibet, pp. 178, 243, 253, 1884 (not of Pallas).

Antelope cuvieri Przewalski, Catalogue of his collections (in Russian), p. 110, 1888 (not of Ogilby).

Procapra (?) *przewalskii* Pocock, Proc. Zool. Soc. London, for 1910, p. 892, 1911; Ann. Mag. Nat. Hist., ser. 9, vol. 2, p. 128, 1918.

Gazella (*Procapra*) *przewalskii* Lydekker, Cat. Ungulate Mamm. Brit. Mus., vol. 3, p. 32, fig. 6, 1914.

Type specimens:—The name is based on the series of specimens secured in the southern Ordos Desert, Mongolia, by the explorer Przewalski about 1875, and deposited by him in the Zoological Museum of the Academy of Sciences in St. Petersburg (now Leningrad). Buechner, in conferring the name, selected no type, but mentioned "mehreren Exemplaren für die Sammlung," so that probably the entire series should be considered cotypes.

Description:—"General colour in the thick winter coat pale finely grizzled fawn, in summer deep fawn; sides of neck and tip of nose brownish in summer; a narrow line of fawn running from the back to the upper surface of the tail divides the white rump-patch; limbs more or less brown in front" (Lydekker, 1914, p. 34). Tail very short, hidden in the fur.

The horns are described as rather shorter than in *P. picticaudata*, much compressed laterally with the exception of the terminal two inches, divergent and evenly curved backward, with the tips abruptly hooked inward and slightly upward.

Sclater and Thomas describe the skull as similar to that of *P. picticaudata* but slightly larger, with a basal length of about 7 inches (180 mm.) but this is not greater than in that animal.

Measurements:—None available, but the size is nearly that of the Tibetan Gazelle or possibly slightly larger of body with shorter horns. "Rowland

Ward's Records of Big Game" gives the height at the shoulder as about 26 inches (660 mm.) and the length of the largest horns, as measured on the front curve, as 12.5 inches (320 mm.), with 4.5 inches (115 mm.) from tip to tip. These measurements do not seem essentially different in the two, but Adlerberg (1931), in his key to the antelopes of the region of northern Tibet, separates this gazelle from typical *P. picticaudata* on the ground of its longer skull, condylobasal length 185-220 mm. against 165-185 for the latter.

Nomenclature:—The first accounts of this gazelle were those of Przewalski in his work describing his travels in Mongolia, but he confused the animal with "*Antilope gutturosa*," the Mongolian Gazelle, a mistake which he later recognized, renaming it *Antilope cuvieri*. Unfortunately this name had been previously applied by Ogilby to an African gazelle, so that Buechner in 1892 gave it the name *Gazella przewalskii*. Although thus recognized as a species distinct from *Procapra picticaudata*, the actual differences seem difficult to find. The color of the two is admitted by Sclater and Thomas and by Lydekker to be practically the same, so that the distinction comes to a matter of size, with the Przewalski's Gazelle believed to be slightly larger. The skull measurements above quoted hardly bear this out, however, so that the chief difference finally comes down to the "distinct hooks formed by the tips of the horns of the bucks" ("Rowland Ward's Records of Big Game," 9th edition, 1928). Under these circumstances it seems evident that either there is no difference at all or it is at most a geographic one, so that I have ventured to consider the Kansu and Ordos animal as a subspecies of *P. picticaudata*. Pousargues (1898b, p. 182) has even suggested that Przewalski's Gazelle may be a hybrid between *P. picticaudata* and the Goitred Gazelle (*Gazella subgutturosa*), but the characters do not seem intermediate. Adlerberg (1931) has published figures contrasting the auditory region of these two species, bringing out the larger bulla, longer auditory meatus and paroccipital process and smaller orbit of the latter. He writes: "Three skulls of *Gazella przewalskii* from Eastern Kan-su distinctly differ from the North-Tibetan ones by their large dimensions, their nasal bones and more raised horns; it may be that *G. przewalskii* forms two geographical races: a bigger (typical?) eastern form, and a smaller one westward of the upper course of the Hwang-ho," but how the latter might differ from *P. picticaudata* is not indicated in the English summary of his paper (in Russian).

Occurrence and Habits:—The range of this race is difficult to define on account of the lack of records, but may provisionally be taken as the Ordos Desert of southern Mongolia, westward into Alashan and to the north-central borders of Kansu. In the first-named area Przewalski seems to have met with it "in large numbers," but as he did not distinguish it from the Mongolian

Gazelle, his account probably applies only in part. The only recent traveler to publish observations on the animal seems to be H. F. Wallace (1913, p. 248), who met with it at a place called Shiakou, about half-way between Liangchow and Kanchow in northwestern Kansu to the north of the Richthofen Range. In his book on "The Big Game of Central and Western China," he reproduces photographs of a head and two of the specimens which he secured. He mentions the "strongly hooked tips to the horns of the males" whereby the species can be recognized, the short pointed ears, the yellower color in winter than in summer, and the darker nose of the adult males. "Those we saw were scattered about the hills which rose on the far side of what was left of the Great Wall, half a mile from the road." A small herd of eight or nine, containing only one buck, was stalked and the latter killed. He later saw a larger company and secured a pair. The British Museum has specimens from the Koko Mountains, Kansu. The young are said to be born in May.

A. B. Howell (1929) mentions specimens in the U. S. National Museum from eighty miles south-southwest of Ningsia (Kansu) and one hundred and fifty-seven miles west-northwest of Paotowchen, Inner Mongolia, distinguished by the longer black tail, tufted fore legs, and duller color, but these are characters of *Gazella subgutturosa*.

Specimens examined:—None.

Genus *Gazella* Lichtenstein

GAZELLES

Gazella Lichtenstein, Mag. Gesellsch. Naturf. Freunde, Berlin, vol. 6, p. 152, 1814 (as subgenus of *Antelope*).
Ogilby, Proc. Zool. Soc. London, for 1836, p. 137, June 27, 1837 (raised to generic rank). P. L. Sclater and Thomas, Book of Antelopes, pt. 10, p. 65, 1898 (type fixed).

With the subdivision of the genus *Gazella* as used by many of the older authors, the determination of the type became necessary, and this was done by P. L. Sclater and Thomas in 1898, for they say that, since *G. subgutturosa* is the only species common to Lichtenstein's first paper proposing the name and the later paper of Blainville from which it had been customarily quoted, the only way "in which the name *Gazella* can be properly retained for this group is by regarding *G. subgutturosa* as its type."

In external characters typical *Gazella* differs from allied genera in that both sexes usually bear horns, those of the male larger and more ridged (transversely) than those of the female; the tail is rather short but not a mere stump; the mammae normally two, inguinal. Pocock (1918) points out further that all have preorbital, inguinal, carpal (or "knee") glands as well as foot glands, the last forming long, deep interdigital clefts of even depth throughout. The rhinarium is a "small irregularly pentagonal moist area on the narial septum, and not, or only to a very small extent, bordering the nostrils above." The

PLATE XV



Mongolian Gazelle (*Prodocas gutturosa gutturosa*), a male with a swollen throat, killed near Urga, Outer Mongolia



Hillier's Goitred Gazelle (*Gazella subgutturosa hillieriana*), shot near Tsagan Nor in the Gobi

urethral canal usually surpasses the glans penis but very slightly. The carpal glands are marked by a prominent tuft of stiffer, longer hairs. In the skull there is a depression in front of the eye for the reception of the preorbital gland. The nasal bones are relatively short and instead of tapering distally to a median point are usually nearly truncate across with a shallow notch in the end of each. As thus restricted, but a single species reaches northern China and Mongolia.

499. *Gazella subgutturosa hillieriana* Heude

HILLIER'S GOITRED GAZELLE

Gazella hillieriana and *G. mongolica* Heude, Mém. concern. l'Hist. Nat. de l'Emp. Chin., vol. 2, pt. 4, p. 245, pls. 36, 37, 1894.

Gazella subgutturosa hillieriana G. M. Allen, Amer. Mus. Novitates, no. 410, p. 10, 1930.

Antelope or *Gazella subgutturosa* of authors (in part).

Type specimen.—No specimen is designated as the type, but Heude's original specimen may be in the Sikawei Museum, Shanghai, if it be identifiable. He mentions no locality, but the name as well as his *G. mongolica* doubtless applies to the animal of the Gobi, presumably eastern Mongolia. The skull figured by Heude seems to have been the basis of his description.

Description.—General color very pale, the muzzle from the upper lips to the level of the eyes white with a slight buffy tinge; forehead between the eyes to the base of the horns and the occiput, gray mixed with buffy or with a sprinkling of black hairs, and varying to white or buffy white. Facial stripe from the suborbital gland forward toward the upper lip, tawny, paling out in front with the intermixture of whitish or pale sandy hairs. In some animals the entire forehead and sides of the face are white, without trace of the facial stripe, but in most cases the part below the eye at least is indicated. Pousargues believes that the facial stripes tend to become obsolete with age. Ears sandy buff externally, white within. Lower lip and central line of the throat white, continuous with the white of the chest, belly and inside of the limbs. General color of the upper parts from the sides of the face posteriorly, sandy, about "pinkish cinnamon" of Ridgway, becoming intensified to cinnamon along a narrow area at the sides of the body, to form a very indistinct band or stripe. On the haunches and outer side of the hind leg and on the sides of the neck the tint is paler on account of a slight admixture of white. On the buttocks the white of the ventral surface extends forward about an inch beyond the base of the tail but leaves a narrow area in the median line connecting the cinnamon of the body with the back of the tail which is blackish brown mixed on the basal half with ochraceous-tipped hairs and a few that are all white. There is a tuft of dark-brown hair at the inner base of each hoof. The knee tufts

are well marked, of longer stiff hairs, of a sand color with a small admixture of white and dark brown.

In winter the color is much paler and the coat thicker. In the rutting season, the laryngeal region of the males becomes much swollen.

The horns are slightly and regularly curved backward for the greater part of their length, with a gentle upward sweep terminally, and diverge posteriorly, their tips, however, turning inward a little. They are transversely ringed throughout, all but the extreme ends. In the female, contrary to the usual condition in the species of this genus, the horns are but little developed, hardly more than small knobs some 3 mm. high. The large globose audital bullæ are in striking contrast to the smaller ones of the other Mongolian gazelles, as are also the notched nasals.

Measurements:—No series of external measurements is available. The size, however, is in general about as in the other Mongolian species, with a shoulder height of about 26 inches, but the tail is decidedly longer, measuring about 120-140 mm. without the hairs. Length of hoofs about 47 mm.

CRANIAL MEASUREMENTS OF *GAZELLA SUBGUTTUROSA HILLIERIANA*

No.	Great- est length	Basal length	Palatal length	Orbit to tip of rostrum	Zygomatic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Sex	Locality
57238	190	176	97	96.0	86.0	69.0	52.5	64.0	67.0	♂	Mongolia
57263	197	182	101	101.0	88.0	70.5	60.5	65.0	—	♂	Mongolia
57266	200	184	—	103.0	87.5	71.0	—	63.0	—	♂	Mongolia
60381	195	180	100	100.0	87.0	70.5	54.0	64.0	(71.0)	♂	Mongolia
46443	179	164	93	95.0	81.5	63.0	50.0	61.5	65.0	♀	Mongolia
46477	194	179	107	102.5	88.0	72.0	57.0	62.5	66.0	♀	Mongolia
46474	201	188	111	108.0	88.0	68.0	55.4	61.0	64.0	♀	Mongolia
57280	196	183	109	106.0	89.0	68.0	59.0	62.5	65.5	♀	Mongolia
57281	196	176	104	103.0	88.0	69.0	60.5	60.0	61.0	♀	Mongolia

In "Rowland Ward's Records of Big Game" (9th edition, 1928) the longest horn, as measured on the front curve, for a Chinese or Mongolian specimen is 12.25 inches (310 mm.) which is 3.5 inches less than that of the largest Persian head representing the typical subspecies.

Nomenclature:—The type locality of *Gazella s. subgutturosa* is Persia, so that, although no Persian specimens are available for comparison, the likelihood that the northern animal of the Gobi is subspecifically different is so great that I have provisionally used for the latter the name *hillieriana* as a trinomial, although proposed by Heude along with *Gazella mongolica* in a specific sense to indicate individual differences in the horns and skulls of two specimens probably from the eastern end of the Mongolian plateau.

A detailed map of North China and surrounding regions. The map includes latitude and longitude lines. Key regions and provinces labeled include: Kiang, Mongolia (Outer and Inner), Ningxia, Suiyuan, Chinghai (Kokonor), Kansu, Shansi, and Honan. Major cities like Lanchow, Suiyuan, and Ningxia are marked. The map also shows the Yellow River and the Great Wall.

of the west and north edges of the Koko Nor basin and along the north slope of the Nan Shan to Alashan. Where, if at all, intergradation between the Mongolian race and the typical form to the westward may take place is yet to be made out. Buechner (1892) wrote that it was found commonly in the southern Ordos, going singly or in small troops, by the Russian explorers Potanin and Berezovski. In this region it apparently reaches the very edge of northern Kansu. Wallace (1913) saw them almost daily between Kanchow and Hami in small bands, the "hwang-yang" or Yellow Sheep of the Chinese. He describes the tail as quite black in color and the inguinal glands as a conspicuous feature of both sexes, and about 1.5 inches deep. "The young . . . are born in June." The rutting season is said to be December and January,

at which time the necks of the bucks are considerably swollen. "When in pursuit of a female the buck holds his tail straight up in the air" (Wallace). He found these gazelles in mid-January in small bands of a male and three to half a dozen does on very bare open plains country, sometimes "on absolutely level, stony ground dotted with miserable, stunted bushes," or again in hollows, half hidden by clumps of long yellow grass, but always wary and difficult to approach, seldom allowing the hunter to come within two hundred yards. Dr. Roy C. Andrews found this species to be typically a desert-lover, preferring arid country with scant vegetation rather than the grassy plains which are the especial home of *Prodocas gutturosa*. This preference results in the practical absence of the Goitred Gazelle from the northern parts of Mongolia, but in the southern parts of this country they follow the desert eastward to about the region of Kalgan on the southeastern edge of the Mongolian plateau. In his march across from Kalgan to Urga, he saw many between Pangkiang and Tuerin, but none between the latter point and Urga, nor between Urga and Sainnoin Khan to the west and southwest, for their place is taken in this grass-land area by the other species (*Prodocas*). Rarely the two may be found in the same herds where these types of country meet, but since the present species is decidedly a desert animal, it does not gather into such large bands. He writes: "At Loh there were hundreds of gazelle all of this species except two of the other and mostly females. On the great plain just north of Tsagan Nor it was present in extraordinary numbers, and here the males far out-numbered the females. The bucks were in herds of four or five to 30 or 35, and of all ages from oldest to two years old. We saw a few herds of two or three females with as many young and one or two bucks. As a rule, however, the latter were together and the females either alone or in couples with their young. A few times we saw one female with two young but not often, usually with but one young. At Loh a young one about ten days old was caught on June 27th, and all the adult females were in milk." The country about Loh he describes as a plain about five miles wide in a north-south direction and extending for many miles east and west. To the north is a range of low but very rough mountains. The plain is of rather fine gravel mixed with a little sand and sparsely covered with bunches of grass about three inches high and with here and there a clump of desert bushes. There are many typical "bad-land" ravines, buttes and knolls of absolutely clean sand and clay, very red and without a spear of vegetation, forming an absolutely desert region. In the dry river bottom are a lot of sand "nigger heads" topped with a "sage-brush" growth. Dr. Andrews remarks on the speed and endurance of these gazelles. "Their gait is strikingly different in running from that of the other species. When not going at full speed they progress in a series of bounds which make the animal appear to be on springs; but when going at top speed they seldom

bound, but their gait is an even run." When in full flight, "there is no doubt but that they can reach sixty miles an hour for a short distance." Pursued with a motor car, they would run only as fast as necessary to keep about 200 yards distant. "We ran one buck for ten miles at an average speed of thirty miles an hour; he would sometimes spurt to forty miles but most of the time kept steadily along at thirty miles. Even the young can run for several miles at from 25-35 miles per hour, averaging at first about 25 miles, with occasional spurts. One adult easily ran away from a car going at forty miles an hour. They were at times found associating with wild asses in the desert." Westward of the central Gobi the range is doubtless continuous through the central deserts to Persia. Reymond (1932), in a journey from Kalgan westward to Kansu and towards Chinese Turkestan, emphasizes the strong difference in habitat preference of this gazelle as contrasted with *Prodocas*, for the latter was found in abundance in the grassy plains and better watered steppes, while *Gazella s. hillieriana* is in the more arid country of the southern Mongolian deserts. Beyond Ashatu, a Mongol military post on the border of the high grassy steppes, in passing to semiarid and bare desert this species was the one encountered, usually in small bands of from two to five. Much farther west, in the bad-lands at the foot of "Pagh-Motton-Sumu," more were seen, but beyond this point in traversing very bare desert none was met with until reaching grassy plains beyond Etsin Gol.

Specimens examined:—The following forty-three:

Mongolia: northwest of Kalgan, 1; Tsagan Nor, 32; Loh, 2; Shara Murun, 1; no exact locality, 7.

Genus *Capricornis* Ogilby

SEROWS

Capricornis Ogilby, Proc. Zool. Soc. London, for 1836, p. 139, June 27, 1837. Pocock, Ann. Mag. Nat. Hist., ser. 8, vol. 1, p. 187, 1908; Proc. Zool. Soc. London, 1910, p. 174. Heude, Mém. concern. l'Hist. Nat. de l'Emp. Chin., vol. 2, pt. 4, p. 222, 1894.

Nemorhedus Hamilton Smith, in Griffith, Animal Kingdom by Cuvier, vol. 5, p. 352, 1827 (in part).

Nemotragus, *Lithotragus*, *Australitragus* Heude, Mém. concern. l'Hist. Nat. de l'Emp. Chin., vol. 4, pt. 1, p. 13, 1898.

This genus is the most primitive in its general characters of the three Asiatic genera of "goat antelopes." The members are, however, larger than the gorals, of stout but rather lanky build, with long, narrow, pointed ears, a dorsal crest or mane on the neck, short tail of about half the length of the foot, naked rhinarium comprising the entire tip of the rostrum, even across in its dorsal outline, and provided in both sexes with short, pointed horns extending straight backward but slightly decurved, and marked with narrow transverse rings in their basal three-fourths. The horns are about as long as the portion

of the skull in front of them. The mammæ are two pairs, inguinal, as in the Cervidæ, and there are foot glands present. The skull shows a number of interesting characters in comparison with the sheep and goats. There is a shallow depression or pit occupying most of the lachrymal bone, for the reception of the suborbital gland as in the deer, but the bone is large and articulates closely with the frontal and nasal instead of being separated from them by a vacuity as in deer and goats. The nasal bones are wide basally, tapering to a median point distally; they abut squarely against the anterior ends of the frontals and continue their lateral contour. Laterally they are in close union with the anterodorsal border of the lachrymals, and partly with the upper border of the maxillaries, but distally lose their contact with the latter. The premaxillaries, instead of touching the nasals at their upper ends, do not quite reach these bones, but the interval is much nearer being closed than in *Næmorhedus*. The basicranial axis forms a wide angle with the palate, but even so is less bent than in the latter genus. The bony ridge below the orbit which marks the dorsal extent of the facial muscles does not reach the level of the orbit, whereas in the latter genus it extends forward half-way up in front of the orbit. The lower incisors have short, nearly spatulate crowns with the antero-external angle of the central ones rather squared than produced outward. The upper premolars have well-developed vertical ridges at the front and back corners exteriorly, while the molars have similar ridges at the front and middle of the outer side, marking the outer corner of the two crescents. There are no accessory enamel columns between the transverse crests of the molars.

Pocock (1918) has described the preorbital gland as a thick-walled, nearly spherical sack, "absolutely packed with long hairs growing nearly vertically from its walls and protruding as a tuft from the small, circular, non-valvular orifice." He found pedal glands on both fore and hind feet, opening by a small circular orifice anteriorly, at the summit of the interdigital cleft, "exactly as in *Ovis* and *Næmorhedus*." In the skeleton of the limbs, the radius and ulna, though closely appressed, remain separate at least until the animal is fully adult.

This genus is represented by but one or two living species, found from Sumatra and the Malay Peninsula to Kashmir and the mountains of western and eastern China. It has been divided into a number of local races of which Lydekker (1913) regarded no less than nine as valid, with a second species from eastern China, which, as Pocock shows, is hardly more than another race. The type species is *Antilope thar* Hodgson, a race of *Capricornis sumatraensis* Bechstein. Three races are probably to be distinguished among the Chinese serows, but the color differences are variable so that their discrimination requires a comparison of representative series. A dwarf species is found in Japan.

KEY TO CHINESE RACES OF *Capricornis*

- A. Colors averaging darker, a contrasted spot of bright tan on sides of muzzle.
 a. Posterior narial opening narrower, about 35 mm. *C. sumatraensis milne-edwardsii*
 b. Posterior narial opening wider, about 45 mm. *C. sumatraensis montinus*
- B. Colors averaging duller, sides of muzzle dark brown, white throat-patch well developed. *C. sumatraensis argyrochætes*

500. *Capricornis sumatraensis milne-edwardsii* David

MILNE-EDWARDS'S SEROW

Capricornis milne-edwardsii David, Nouv. Arch. Mus. d'Hist. Nat. Paris, vol. 5, Bull., p. 10, 1869.

Nemorhedus edwardsii David, *ibid.*, vol. 7, Bull., p. 90, 1871.

Antilope (Nemorhedus) edwardsii Milne-Edwards, Recherches pour servir à l'Hist. Nat. des Mammifères, p. 364, pls. 72, 73, 1868-74.

Capricornis edwardsii Heude, Mém. concern. l'Hist. Nat. de l'Emp. Chin., vol. 2, pt. 4, p. 232, 1894.

Nemorhædus sumatrensis milne-edwardsi Lydekker, Game Animals of India, p. 143, 1907.

Capricornis sumatraensis milne-edwardsi Pocock, Proc. Zool. Soc. London, 1908, p. 175.

Capricornis sumatrensis milne-edwardsi G. M. Allen, Mem. Mus. Comp. Zool., vol. 40, p. 203, 1912.

The following are likewise synonyms of this race, based on specimens from Muping, Szechwan, or western China:

Capricornis platyrhinus, *C. cornutus*, *C. erythropygius* (or *erythropygius*), *C. microdontus*, *C. ungulosus*, *C. nasutus*, *C. vidianus*, *C. fargesianus*, *C. brachyrhinus*, *C. pugnax*, *C. longicornis*, *C. chrysochætes* Heude, Mém. concern.

l'Hist. Nat. de l'Emp. Chin., vol. 2, pt. 4, pp. 232, 233, 1894; *ibid.*, vol. 3, pt. 3, p. 151, 1897; *ibid.*, vol. 3, pt. 4, pp. 195-198, pls. 34-39, 1897; *ibid.*, vol. 4, pt. 1, pp. 1-14, pls. 1-4, 1898.

Capricornis osborni Andrews, Amer. Mus. Novitates, no. 6, pp. 1-3, 1921. Tengyueh, Yunnan.

Type specimens.—The type specimens were apparently two from Muping, western Szechwan, China, collected by Père Armand David and sent by him to the Paris Museum about 1869. Milne-Edwards has figured the skin in color as mounted and the skull in his "Recherches."

Description.—This race of western China is apparently characterized by its darker coloring, the entire body usually deep black superficially, but the bases of the hairs grayish to whitish, and a median stripe of all-black hairs extending down the back to the basal half of the tail. The forehead and face are black, sometimes slightly grizzled with whitish, and there is usually a tan-colored spot on each side of the muzzle. The lower lips are white, but the interramal area is black like the rest of the throat. The long hairs of the mane are usually black, but may be in part or mostly dull whitish, even in individuals from the same locality. Feet from the knee down and from the middle of the haunches, ferruginous, this color in the hind legs extending upward along the edge of the buttocks to the base of the tail. Inside of the upper part of the hind legs whitish. Tail black at the tip, then usually russet in its middle third and blackish mixed with gray basally, but the black line of the back extends on to the basal half. There is apparently a good deal of variation in the amount of black and whitish. Ears black exteriorly, sometimes grizzled slightly, the inside at the base lined with long white hairs.

The skulls, when a series is examined, present many variations in the form of the nasals. In some they are narrow and squarely truncate behind, while in others they are broader, and they may be in contact not only with the entire dorsal edge of the maxillary, but occasionally even with the tip of the ascending process of the premaxillary, though usually there is a considerable gap between the latter and the nasal. The large lachrymal bone, with its shallow but extensive pit, articulates closely with the frontal and nasal as already mentioned; the forehead is flattened, and the nasals continue the straight profile of the face.

Among other generic characters Heude calls attention to the deer-like last milk molar.

Measurements.—The following flesh measurements were made by W. R. Zappey from two adult females killed at Wa Shan, Szechwan:

No.	Total length	Tail	Hind foot	Height at shoulder	Height at hip
16488 MCZ	1590	115	380	860	790
17345 MCZ	1675	120	388	900	850

A third female (type of *C. osborni*) from Tengyueh, Yunnan, not fully adult, measured: total length, 1,530 mm.; tail, 180; hind foot, 390; ear, 175.

"Rowland Ward's Records of Big Game" gives as the longest Chinese horns a pair from Tatsienlu measuring 10.5 inches, the record length being an inch more for one from the Mishmi Hills. The weight is said to be about 200 pounds. In general measurements males and females do not seem to differ materially.

CRANIAL MEASUREMENTS OF *CAPRICORNIS*

No.	Condylor-basal length	Basal length	Pala-tal length	Length of nasals	Zygo-matic width	Mas-toid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Sex	Locality
<i>C. sumatraensis milne-edwardsii</i>											
13247 MCZ	292	274	172	89	124.0	85.5	82.0	97.0	102.5	♂	Szechwan
17345 MCZ	294	277	172	101	134.0	92.5	86.5	95.0	98.0	♀	Szechwan
<i>C. sumatraensis montinus</i>											
43037	292	275	170	98	126.0	87.0	93.0	90.0	93.0	♂	Yunnan
43038	290	274	169	106	132.0	85.0	86.0	85.0	88.0	♂	Yunnan
43039	295	279	172	98	129.0	91.0	87.0	84.0	87.0	♂	Yunnan
<i>C. sumatraensis argyrochates</i>											
45348	306	286	173	125	137.0	92.0	81.0	88.5	95.5	♂	Chekiang
45349	283	266	160	87	131.0	83.0	77.0	89.0	93.0	♂	Chekiang
70451	—	—	172	104	128.0	86.0	86.0	89.0	97.0	♀	Chekiang
44777	295	276	169	100	129.0	90.0	89.0	80.5	91.0	♀	Fukien
44778	291	275	161	92	125.0	86.0	83.0	96.0	100.0	♂	Fukien
56981	300	284	171	108	131.0	87.0	87.0	93.0	98.0	♂	Fukien
56983	297	277	172	110	128.0	88.0	82.0	88.0	92.0	♀	Fukien
84464	284	267	157	103	130.5	87.0	86.0	87.0	92.5	♀	Fukien
84465	298	279	167	114	126.0	86.0	81.0	91.0	96.0	♂	Fukien
84477	275	255	152	95	133.0	87.0	87.0	89.0	95.0	♂	Fukien

Nomenclature.—In 1908 Pocock published a general review of the serows and gorals, pointing out the proper generic names and indicating something of the variation in the animals. Lydekker (1913) in his "Catalogue of the Ungulate Mammals in the British Museum" has also listed the named forms, recognizing various Malayan, Indian and Chinese subspecies of *C. sumatraensis* but retaining *C. argyrochaetes* of eastern China as a distinct species, a conclusion rightly challenged by Pocock in his paper of 1918. There can be no doubt that but a single species is recognizable among them, and even the distinction of races becomes difficult when even small series of skins and skulls are compared, for many of the supposed differences prove to be merely individual variations, with a tendency for red and black on the legs to be more or less extensive or even interchangeable, and the gray of variable amounts. Cranial characters are equally variable within certain limits, until it becomes doubtful if more than a single race can be clearly made out even in China. Earlier, Père Heude gathered a large number of skulls from different parts of China, and although many were from a single locality, he separated them into three groups so far as the continental ones were concerned, namely: *Capricornis* for those with long horns, sometimes converging, to include five new species; *Nemotragus* for those in the same area with shorter and diverging horns, with six new species including *N. argyrochaetes*; and *Lithotragus* for those individuals with uniformly black pelage except on the feet, to include five new species, all from Tongking. His idea of a species, however, implied merely a difference of any sort, and his genera and species represent often the extent of individual variation only. After examining the type specimen of *C. osborni*, I find it to be based on the fact that the body and head are coal black with more black on the lower leg than the average, so that it seems probable that it is but an individual variant of *C. s. milne-edwardsii* from rather lower altitudes near Tengyueh, southwestern Yunnan. Nevertheless the serows from the upper slopes of the Likiang Range have on the average distinctly wider posterior nares than the animals I have seen from elsewhere in this province and Szechwan, so that I named them as a local race, but am prepared to find that it is not so different as the few specimens seemed to indicate. Sowerby (1917) has reexamined the series of serows upon which Heude based so many names (no fewer than twenty-four based on twenty-six specimens!) and has reduced these to not more than five possibly valid races. He believes the white mane is perhaps characteristic of age.

Occurrence and Habits.—For the present the general range of this race may be taken to include western China from southern Kansu southward through Szechwan and most of Yunnan, westward into the edge of Burma, doubtless passing into that of *C. swettenhami* and *C. robinsoni* in the Malay Peninsula. It is found at higher levels among the mountains and may prove

to have a more or less discontinuous range. David found it in Muping in the thickest growth of mountain forest, haunting the cliffs at about 3,000 meters altitude; while M. P. Anderson noted that in western Szechwan, where he collected it, he found it inhabiting forests and cliffs at altitudes above 6,000 feet, and less common than the goral (Thomas, 1912e, p. 141). He secured a specimen in the Si Ho valley. Wallace has given an account of hunting the serow in southern Kansu near Archuen and in the thick fir woods "which clothe the northern slopes of the ridges south of the Tao River." Those he saw seem to have been usually white-maned. He writes that they feed on the grassy southern sides of these ridges during the early morning and retire early into the recesses of the forest. The usual method of hunting them is with dogs which run them till they turn at bay, when the hunters come up and give the final shot. They are well able to defend themselves, and frequently succeed in wounding some of the dogs or dash through them in thick cover along precarious footing among the cliffs, so that they are not easy to approach or to see. Wallace mentions one that he saw at a distance of a mile away "standing on the edge of a slope, and gazing intently down into the valley, a position which he maintained without stirring for three-quarters of an hour." They are adept at dashing rapidly down what seem impassable precipices or slipping away through dense scrub. Their short solid hoofs are well adapted for rock-climbing, and their native name, "ngai lü-tze" or Cliff Donkey, well indicates their characteristic long ears and liking for rugged situations. Wilson (1913) has given a brief summary of his experience with these animals, and mentions their liking for "wild, precipitous, brush-clad country." In the upper Min valley, Szechwan, he adds that on account of the mud shales of which the mountain is composed, landslips are frequent and increase the danger of hunting. In 1893-94 Berezovski found serow in the mountains northwest of Lunganfu, the same region hunted by Wallace, and probably marking nearly the northern limit of the range. Dr. R. C. Andrews has recounted his experiences in hunting the serow in Yunnan where, as usual, they are found amongst steep rocky outcrops and precipitous gorges. He believes that they range nearly continuously from the Snow Mountains to the Burma border and beyond. Little seems to be recorded of the habits. Zappey's experience was that the male and female kept together, but it seems also to be the case that they are usually met with singly, although possibly in winter they may collect into small troops, for Berezovski, who secured an old female in December, 1885, in the Ssigu district, northern Szechwan, speaks of finding them only in the mountain forests, singly or in small bands (Buechner, 1892, p. 161). The flesh, according to E. H. Wilson, is "dark-colored, tough, of poor flavour, and the least desirable meat I have tasted," a consequence, perhaps, of some peculiarity of diet, in addition to the active habits.

Specimens examined.—The following four:

Szechwan: Wa Shan, 2 (M.C.Z.); Tatsienlu, 1 (M.C.Z.).

Yunnan: Tengyueh, 1 (type of *C. osborni*).

501. *Capricornis sumatraensis montinus* G. M. Allen

LIKIANG SEROW

Capricornis sumatraensis montinus G. M. Allen, Amer. Mus. Novitates, no. 410, p. 5, 1930.

Type specimen.—An adult male, skin and skull, No. 43039, American Museum of Natural History, from the Likiang Range, Snow Mountain, Yunnan, China. Collected November 5, 1916, by Dr. Roy C. Andrews.

Description.—Similar to *C. s. milne-edwardsii*, but with the feet whitish or rufous and usually without a black line down the middle of the front. The skull is characterized by the shallowness of the notches at the rear border of the palate and by the greater width and more flaring outline of the posterior narial opening.

The general color is blackish brown, the body hairs in general pale or whitish basally, becoming blackish in the terminal half. Sides of the muzzle with a poorly defined patch of dull ochraceous just back of the tip. Lips white with a white line extending back some four inches from the corner of the mouth, and separated by a narrow blackish area from the white throat-patch that extends forward between the rami of the jaws. Backs of the ears and the area about their bases more or less tawny, mixed with darker which predominates on the terminal third of the ears; insides of the ears white. The long hairs forming the central part of the mane are chiefly whitish, becoming brown at their tips. Both fore and hind feet may be whitish with a slight admixture of pale rusty, more intense in some specimens. In the type the fore feet are bright clear ferruginous, the hind feet with an indication of a blackish stripe down their front; but in other specimens the stripe is obsolete. Along the sides and especially about the edge of the buttocks there is more or less mixture of rusty hairs. The belly and inguinal region are whitish.

The distinctive features of the skull in comparison with the two other Chinese races are the wider, more flaring walls of the posterior narial opening, and the much shallower lateral notches of the posterior border of the palate, so that if a straight edge be laid across the hinder border of the last upper molars the palatal notches do not extend anterior to it, whereas in the two other races they extend forward to the level of the middle of the last tooth.

Measurements.—The following field measurements were taken of the type and three topotypes:

No.	Head and body	Tail	Hind foot	Ear	Sex	Locality
43037	1530	—	400	200	♂	Yunnan
43038	1500	85	400	200	♂	Yunnan
43039 (type)	1620	80	400	190	♂	Yunnan
43040	1600	90	420	200	♂	Yunnan

The width across the posterior narial passage in the type is 44 mm., in contrast to slightly over 30 in specimens of *C. s. milne-edwardsii* from Wa Shan.

For other cranial measurements, see the table under the latter race.

Occurrence and Habits.—While color characters alone form a rather insecure basis for the separation of a distinct race of serow on the Likiang range, the marked difference in the width of the posterior nasal passages and the shallowness of the lateral notches of the palate seem to be on the whole borne out in the series examined, so that with some hesitation I named the animal, notwithstanding that the characters may with a large number of specimens prove to be less striking. It is perhaps confined to the high isolated range of snow peaks of the Likiang Range in the great bend of the Yangtze, the fauna of which shows a few other peculiarities due to its isolation, such as the absence of the microtine subgenus *Neodon*. The range of the serow here is at high levels. Dr. Andrews writes: "On the Snow Mountain we found them living singly at altitudes of from 9,000 to 13,000 feet in dense spruce forests, among the cliffs." They were apparently in the habit of sleeping under overhanging rocks, for he frequently found beds in such situations that showed signs of use. The cover here is exceedingly thick, but apparently the animals seldom come out into the open, preferring to feed on grass and leaves in the shelter of the thickets. They are usually hunted with dogs, but may often lead the latter for three or four miles and finally elude them, or they may turn at bay and fight the pack after only a short chase. "A large serow is almost certain to kill several of the hounds if in a favorable position with a rock wall at its back. The animal can use its strong curved horns with deadly effect for it is remarkably agile for a beast of its size" (Andrews, R. C. and Y. B., 1918, p. 143).

Specimens examined.—Four males, from the Snow Peak, Likiang Range, Yunnan—type and topotypes.

502. *Capricornis sumatraensis argyrochætes* Heude

EASTERN SEROW

Capricornis argyrochætes Heude, Mém. concern. l'Hist. Nat. de l'Emp. Chin., vol. 2, pt. 1, p. 4, footnote, 1888; *ibid.*, vol. 2, pt. 4, p. 228, pl. 31, figs. 1-4, 7, 8, 10, 11, 1894. Lydekker, Cat. Ungulate Mamm. Brit. Mus., vol. 1, p. 196, 1913.

Capricornis maxillaris Heude, Mém. concern. l'Hist. Nat. de l'Emp. Chin., vol. 2, pt. 4, p. 229, pl. 31, figs. 5, 6, 9, 9', 1894. Chaohing, Chekiang.

Nemotragus argyrochætes Heude, *ibid.*, vol. 4, pt. 1, p. 13, 1898.

Capricornis collasinus Heude, *ibid.*, vol. 4, pt. 4, p. 211, pl. 42, figs. 5-8, 1899. Sowerby, Proc. Zool. Soc. London, 1917, p. 23. Kwangtung.

Nemorhadus argyrochates Lydekker, Proc. Zool. Soc. London, 1905, vol. 2, p. 329, pl. 8 (colored); *ibid.*, for 1908, p. 940, 1909.

Capricornis sumatraensis argyrochates Pocock, Proc. Zool. Soc. London, 1908, pp. 175, 185.

Nemorhadus collasinus Mell, Arch. f. Naturgesch., vol. 88, sect. A, no. 10, p. 31, 1922.

Type specimen.—The name was based chiefly on a skull from Chaohingfu (Hsaoshingfu), Chekiang, China, forming part of the collection assembled by Père Heude at Shanghai. According to Sowerby (1917), it is at present in the Sikawei Museum, Shanghai, together with other skulls on which various names were based by the same author.

Description.—The eastern Chinese serow differs remarkably little from that of western China. An adult male from Chekiang in summer may be described as follows: Lips narrowly edged with whitish, this mark extending back as a broad white streak from the corner of the mouth. No white throat-patch, although many of the hairs are tipped narrowly or broadly with white. An area just back of the nostril dark brown, slightly mixed with gray and buff; backs of the ears mixed blackish and ochraceous on the basal three-quarters, becoming darker near the tips, their inner side lined with white hairs, long and projecting on the edges. The long stiff hairs of the mane are chiefly grayish white, clouded with buffy on the terminal half or more. The rest of the body generally blackish, the hairs of the median area of the back largely whitish at the base with blackish tips; belly and inguinal region with a few ochraceous hairs mixed with the black. On the knees the black passes into rusty, slightly mixed with whitish hairs at the sides and rear, while below the knee to the hoof is a darkened area, chiefly blackish with a few rufous hairs, widening at the hoof. The hind foot is similar except that the dark area forms a continuous black streak much mixed with rufous. There is no under fur but the pelage is coarse and bristly. The short tail is tipped with black, with rusty-colored hair toward the base. A female in winter from the same region is similar but has the white throat-patch well developed; there is a small pale-buffy patch back of the nostril; the white areas are sharper and clearer white, while much of the body has a stiff whitish under coat showing through the coarser black hair. The upper part of the leg and the fore shoulder are much mixed with rusty, and the fore leg below the knee is more or less whitish on the inner side. The hind leg is clearer rusty and lacks the black band down the front. There is much variation in the details of coloration. The white throat-patch may connect with the white lip-marks. One Chekiang specimen was practically black all over except for a slight mixture of rusty at the throat; the lip stripe and chest-patch were separate; the mane whitish.

A small young one from Yenping, Fukien, is interesting in somewhat resembling the young takin by reason of the dull-brown coloring. It is dark

brown all over, the hairs paler at the base, except that the insides of the ears and the edges of the buttocks are white. There is a whorl in the middle of the neck where the slightly longer hairs are white at the base, and there are a few white hairs on the throat making a grizzled patch. The backs of the ears and the fronts of the fore feet are slightly mixed with ochraceous.

There is little to distinguish these eastern animals in color from *C. s. milne-edwardsii*, although usually they lack the tan-colored patch at the sides of the muzzle, but instead it is dull brown, and the general tone of the coat is perhaps browner, less black. The whitish mane, which was supposed by Heude and by Lydekker to be distinctive of this animal, proves to be shared also by the western race, but is perhaps less often replaced by black. Sowerby, after examining a number of skins, believes that it is a characteristic of age rather than of season, but at least it is a very variable one. He mentions a mounted head in the Sikawei Museum from the type locality that "showed no trace of a light mane." He believes that the eastern animal has the rusty brown of the legs "distinctly lighter" while the mane is creamy brown "due to a greater prevalence of chestnut hairs." It must be admitted, however, that these are rather tenuous characters on which to separate the two animals.

The skulls do not differ significantly, as Jacobi (1922) points out.

Measurements:—The size measurements are doubtless much as in the western race, but none are available. The cranial dimensions are not different from those of the western animal in any important particular. For a series of skull measurements, see the table under *C. s. milne-edwardsii*. Sowerby (1926) mentions one killed in Chekiang that weighed 152 catties, or about 200 pounds, and Caldwell, referring to Fukien, says that he has secured a full-grown male in the market, weighing 310 pounds, and one female but a trifle, if any, smaller (290 pounds).

Nomenclature:—Although the eastern serow is very similar to the western race, it is perhaps different enough in its slightly browner color and usual lack of the tan-colored spot at the side of the muzzle to be regarded provisionally as distinct, and it is likely that there will be found seasonal differences in length or nature of the winter coat. Heude's name *C. argyrochaetes* was based upon the whitish mane, but this is shown not to be a reliable character, for the western animals may also be white-maned. Probably Heude's *C. collasinus*, based on an imperfect skull from Kwangtung, is to be considered a synonym, although Sowerby (1917), who examined the original specimen in the Sikawei Museum, is inclined to recognize it provisionally, but largely on geographical grounds. Heude in 1894 gave a third name, *C. maxillaris*, to a serow but as it came from Chekiang and from the same locality as the type of his *C. argyrochaetes*, there can be no question but that it is synonymous with the latter.

PLATE XVI



Eastern Serow (*Capricornis sumatraensis argyrophaces*) in an enclosure. Chekiang



Head of Milne-Edwards's Serow (*Capricornis sumatraensis milne-edwardsii*), killed in Yunnan. Note the opening of the antorbital gland

Pocock in his 1908 review is doubtless correct in placing the various described forms as subspecies of the first-described Sumatran animal.

Occurrence and Habits:—The “shan yang,” or Mountain Goat, of the Chinese still occurs in some numbers in rough mountainous country from Hupeh and Chekiang southward, probably to the border of Tongking and beyond. The most northeasterly locality from which I have recent records of the serow in China is in the Tunglu district of Chekiang, whence the Rev. Harry R. Caldwell secured specimens for the American Museum. He writes (1924) that leaving Tunglu, some sixty miles inland from Hangchow, he went twenty miles up a small creek to the heart of a range of mountains where in late September, 1919, he made headquarters in the little village of Yaw. A stiff climb of some three thousand feet above the plains brought him to the midst of high peaks and rugged crags, above which he had literally to burrow a way through dense brush and tangle to the foot of a steep cliff which was a favored haunt of the animals. “The signs observed during this second day indicated a rutting season and habits much like those of the common deer of eastern United States. I found great patches of newly pawed earth, as well as many trees and shrubs badly horned.” This habit of “horning” trees may in part account for the smooth polish seen on the horns. On the first day of the hunt two were started together, not twenty feet below him, “stopping under a little cover less than two rods away from whence they bombarded me with hisses and snorts.” Soon afterward the beaters started a huge buck which “emerged from the dense cover and dashed across the face of the cliff. The animal had chosen a perfectly safe runway . . . It resembled more a donkey than any animal of the wilds that I had ever seen. Its white mane was bright in the sunlight. The horns so closely in line with the ears gave the head the appearance of that of a mule.” One or two other single animals were started in the same locality on a succeeding day. One, a fine buck, suddenly broke cover at close quarters, and “started across the face of a cliff with the grace of a fawn frisking on a lawn. . . . One could but wonder how any animal could possibly keep its footing upon such a steep and rugged cliff.” Still-hunting is found to be almost useless in the dense brush that they inhabit, but the native hunters sometimes snare them. If pursued by dogs, they will often put up a terrific fight and may unhesitatingly attack a man if cornered. Caldwell regards wapiti and bighorn hunting as child’s play compared with the pursuit of the serow. He adds that their pursuit in the mountainous country of Fukien is even more difficult than in Chekiang. They are common in the mountains about Yenping. Pope found them frequenting all the higher and more rugged cliffs about Kuatun, and describes the native method of making a snare by bending down a single sapling by the trail and preparing a noose which is

jerked up when the animal releases the trigger in passing. Heude (1894a) in writing of this species considers it remarkable that in the high mountains of Chouki, Chekiang, the fauna of Szechwan should be found, as represented by serow, goral, musk deer and tufted deer. South of Fukien, there is little information as to the distribution. That it occurs in Kwangtung, however, was made known by Heude, who described as *C. collasinus* a skull sent him by the missionary P. Collas from the "Mé-ling" Range, separating the Yangtze basin from the sea at the Nanyong divide. Probably, too, it occurs in the mountainous parts of Kweichow and the adjacent regions. To the north, E. H. Wilson (1913) mentions its presence in small numbers in the high mountains of north-western Hupeh, where he and Zappey hunted it in 1908, but after ten days' effort, only once sighted a serow. "A loud, angry snort in the brush, a momentary glance, and all was over," the animal making off through the thickets at fifteen to twenty feet to a bound. They also learned that a few serow are to be found in the high mountains southwest of Ichang, but it is rarer there. The serow of this region are possibly referable to this race. A large pair of horns that Wilson obtained from a local hunter measured $10\frac{3}{4}$ inches in length, which is only slightly less than some of the largest recorded by Ward. Shih (1930) mentions a pair of horns obtained in Yao Shan, Kwangsi. Dr. R. C. Andrews writes that the serows he hunted in Fukien were living in a different type of country from the spruce thickets and crags where he found them in Yunnan. They were on the top of a high mountain clothed with a dense jungle of dwarf bamboo without such high cliffs and interspersed with extensive grassy meadows. The natives said that in late September the animals might at times be found lower down on the mountain slopes in the forest, where they seemed to be attracted by the new-grown mushrooms.

They are present, according to Mell (1922), in all the mountainous regions of northern Kwangtung, in Pak Shan between Tschichin and the borders of Hunan and Kiangsi.

If put to it, the serow will readily take to water and can swim well. Sowerby mentions one killed as it was swimming the Yangtze above Shanghai, where it was brought to market, and Heude tells of another killed by some Chinese fishermen as it was swimming from one to another of the steep-sided rocky islands in the Bay of Along, Indo-China.

Specimens examined:—The following fifteen, in addition to odd pairs of horns:

Chekiang: Tunglu, 4; Mogan Shan, 2.

Fukien: Chunganhsien, 3; Yenping and vicinity, 5.

No exact locality, 1.

Genus *Næmorhedus* Hamilton Smith

GORALS

Næmorhedus Hamilton Smith, in Griffith, Animal Kingdom by Cuvier, vol. 5, p. 352, 1827³ (as a subgenus).

Antilope Hardwicke, Trans. Linn. Soc. London, vol. 14, p. 518, pl. 14, 1825 (in part).

Næmorhædus Jardine, Naturalist's Library, Mammals, vol. 4, p. 277, 1836.

Kemas Ogilby, Proc. Zool. Soc. London, for 1836, p. 138, 1837.

Nemorhedus Gray, List Mamm. Brit. Mus., pp. xxvi and 160, 1843.

Urotragus Gray, Ann. Mag. Nat. Hist., ser. 4, vol. 8, p. 372, 1871.

Cemas Blanford, Fauna British India, Mammalia, p. 516, 1891 (not of Oken, 1816).

Though smaller than the serows, the gorals represent in some respects a more advanced stage of development. The suborbital pit for the reception of a gland is hardly evident beyond a slight depression of the general surface, for as Pocock (1918) has now demonstrated, the suborbital gland is very small, but marked externally by "a very small patch of nearly naked skin covered with dry scurf-like secretion." It is scarcely apparent in dried skins, but whether it "represents a rudimentary or vestigial condition of the pouch-like pre-orbital gland of *Capricornis* must be left an open question." Pedal glands are present but there are no inguinal glands. As in the latter genus, the naked rhinarium is large, extending back as far as the posterior corners of the nostrils, but it is indented on its upper border by the line of the hairy covering. The penis, as figured by Pocock (1918), "is cylindrical, slightly expanded distally, then gradually narrowed to the apex, beyond which the end of the urethral canal is prolonged as a tube for a short distance," thus resembling that of the takin. The tail is longer than in the serow. The skull shows several other important differences as compared with that of the latter. The basicranial axis is much more bent upon the palatal axis, giving the skull a more angular profile; the lachrymal bone is shorter, so that its anterior upper corner is barely in contact, if at all, with the lower angle of the nasals, and the maxillary has lost its contact with the nasal bone on the lateral edge, so that the nasals are supported by their proximal ends only, for the premaxillaries are even shorter than in *Capricornis* and are widely separated dorsally from the nasals. Perhaps on account of these peculiarities, the posterior ends of the latter bones converge to a point where they meet the frontals, thus forming a wedge between them and providing a firmer support, whereas in the serow the posterior outline of the nasals is nearly transverse. The large muscle scar just below the orbit extends upward in front of its anterior boundary nearly to the edge of the lachrymal instead of being ventral to the eye. The teeth are similar to those of the serow except in being smaller, and in having the outer surface of the premolars in the upper jaw nearly smooth, without the vertical ridges at anterior or posterior corners except in the third, which shows the antero-external column thickened. The horns are short and directed backward and slightly downward, the length of their bony cores about equaling the

distance from the orbit to the occiput instead of considerably exceeding it. According to Heude, two lateral metacarpals (2 and 5) are present instead of only one (5) as in the serow.

Although Lydekker recognizes in his review of 1913 two species of goral, each with its geographic races, it seems more likely that all should be regarded as representative forms of a single species which, like the serow, covers a considerable area in southeastern Asia from the Himalayas eastward across China, but does not extend so far south, though penetrating much farther to the northeast into Amurland. A number of species or races have been named, chiefly by Père Heude, who, however, regarded any slight variation as of specific value quite apart from its geographical significance. Probably it is hardly possible to admit more than three more or less well-defined races in China at present, a northeastern, a southeastern, and a western, distinguished by slight average differences in color. In pre-glacial times the gorals seem to have had a much wider westward range, for remains referred to this genus are reported from France. As originally proposed, the genus contained two species, *Antilope sumatraensis* Bechstein of Sumatra, and *A. goral* Hardwicke of Nepal, but with the former transferred to *Capricornis*, the latter becomes the genotype of *Næmorhedus*.

KEY TO CHINESE RACES OF *Næmorhedus*

- A. Throat-patch white, narrowly bordered with pale ochraceous.
 - a. Color averaging paler, base of tail grayer *N. goral caudatus* (northern and northeastern)
 - b. Color averaging darker, base of tail browner; winter coat with less under wool (?)..... *N. goral griseus* (western China)
- B. Throat-patch suffused with pale orange... *N. goral arnouxianus* (southeastern China)

503. *Næmorhedus goral caudatus* (Milne-Edwards)

NORTHEASTERN GORAL

Antilope caudata Milne-Edwards, Ann. des Sci. Nat., Zool., ser. 5, vol. 7, p. 377, 1867; Recherches pour servir à l'Hist. Nat. des Mammifères, p. 186, pls. 23, 23a, 23b, 1868-74.

Antilope (Caprina) crispa Radde, Reisen im Süden von Ost-Sibirien, vol. 1, p. 262, pl. 12, 1862 (not of Temminck).

Urotragus caudatus Gray, Ann. Mag. Nat. Hist., ser. 4, vol. 8, p. 371, 1871.

Nemorhædus caudatus W. L. Sclater, Cat. Mammals Indian Mus., Calcutta, pt. 2, p. 340, 1891. Lydekker, Cat. Ungulate Mamm. Brit. Mus., vol. 1, p. 208, 1913.

Cemas caudata Blanford, Fauna British India, Mammalia, p. 516, 1891.

Kemas galeanus Heude, Mém. concern. l'Hist. Nat. de l'Emp. Chin., vol. 2, pt. 4, p. 243, 1894. Yu Ho Mountains, southern Shensi.

Kemas vidianus Heude, loc. cit. Yu Ho Mountains, southern Shensi.

Urotragus galeanus Sowerby, in Clark and Sowerby, Through Shên-kan, p. 175, 1912.

Næmorhedus goral caudatus G. M. Allen, Amer. Mus. Novitates, no. 410, p. 6, 1930.

Type specimen.—Milne-Edwards based the name *Antilope caudata* upon

the description given by Radde (1862) of a goral from the Bureja Mountains, Amurland, the characters of which Radde describes in detail, but wrongly supposed his animal to be the same as the Japanese "*Antilope*" *crispa*. Radde's specimen therefore becomes the type of *Næmorhedus caudatus*. In his particular account of the specimen, he says that he secured it in the highlands that slope away to the Lagar River, a tributary of the Amur. The locality is thus a thousand miles to the northeast of Peiping, and the specimen, a skin and skull, is presumably in the Zoological Museum of the Academy of Sciences at Leningrad.

Description.—Skins from Tungling, Hopei, provisionally taken to represent this race, illustrate extremes in color variation, one being a uniform pale buffy gray on the body, only slightly darkened by the short blackish tips to the guard hairs; the other is much darker and browner in general appearance, due to the more abundant dark-brown over-hairs with their longer brown tips. The woolly under-hairs are gray and nearly as long in the winter pelage as the guard hairs. In the grayer specimen the front of the fore and hind feet is nearly whitish, slightly washed with buffy, but in the browner animal these parts are almost ferruginous. In the former the forehead, chin and throat are grizzled like the back, but in the latter these areas are dark brown. Both have the usual dark spinal stripe, the throat-patch is white and the insides of the ears are thinly clad with white hairs. Four other skins from Hopei and Shansi more nearly resemble the grayer individual. The throat-patch in all is nearly clear white, narrowly bordered with pale ochraceous. The base of the tail in unworn skins is mixed gray like the back. A specimen from Tungling in full winter coat (January 18) has the longest hairs of the short mane 135 mm. long, as against a length of about 85 mm. for those in the center of the back.

The general characters of the skull have been mentioned under the diagnosis of the genus. Radde (1862) has published measurements of that of the type.

Measurements.—Few flesh measurements of northeastern specimens are available. Those given by Radde for the type from the Bureja Mountains are: total length in a straight line, 51 inches (1,295 mm.); tail, $4\frac{1}{3}$ inches (110 mm.); with the terminal tuft of hair, $14\frac{5}{12}$ inches (368 mm.); ear, $5\frac{1}{12}$ inches (130 mm.); height at shoulder, 28 inches (713 mm.).

Möllendorff (1876a) gives the following measurements of a male believed to be about three years old, killed apparently near Peiping: length from tip of nose to base of tail, 1,200 mm.; tail, 330; fore leg from elbow to "sole" of hoof, 415; hind leg from hoof to knee, 562; ear, length posteriorly, 170; width, 70; length of horn on the outer curve, 188; circumference at base, 110; tip to tip, 100.

CRANIAL MEASUREMENTS OF *NEMORHEDUS*

No.	Greatest length	Basal length	Palatal length	Zygomatic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Orbit to tip of rostrum	Sex	Locality
<i>N. goral caudatus</i>											
45330	207	188	118	94.0	67.0	62.0	71.0	72.0	118	♂	Hopei
45487	216	193	122	100.0	72.0	62.5	67.0	71.5	122	♂	Shansi
57292	212	183	121	102.0	69.0	62.0	73.0	76.0	120	♀	Shansi
57295	207	186	122	96.0	69.0	62.5	69.0	74.0	120	♀	Shansi
<i>N. goral arnouxiannus</i>											
45331	213	185	120	94.0	70.0	62.5	70.0	71.0	122	♂	Chekian
17348 MCZ	210	190	117	102.0	70.0	62.5	68.5	67.0	115	♂	Hupeh
17349 MCZ	216	195	122	95.0	73.0	62.5	69.0	69.0	119	♀	Hupeh
17350 MCZ	225	—	120	98.5	74.0	65.0	69.5	71.0	124	♀	Hupeh
8134 MCZ	216	195	123	94.0	68.0	57.0	71.0	76.0	115	—	Hupeh
16493 MCZ	212	185	117	93.0	69.0	60.5	66.5	69.0	116	♂	Hupeh
<i>N. goral griseus</i>											
43004	210	186	118	93.0	70.0	59.0	66.0	66.0	117	♂	Yunnan
43013	195	175	95	91.0	67.5	61.0	64.5	67.0	105	♂	Yunnan
43027	184	164	99	91.0	61.0	60.0	66.0	65.0	103	♂	Yunnan
43033	201	181	112	93.0	64.0	60.0	66.0	69.0	110	♂	Yunnan
43031	203	180	108	95.0	69.0	61.0	63.5	65.5	110	♂	Yunnan
43034	207	187	115	90.5	68.0	58.0	62.0	64.0	113	♀	Yunnan
43030	205	185	115	93.5	71.0	62.0	65.0	70.0	113	♀	Yunnan
43008	197	172	109	91.0	66.0	58.0	60.0	65.0	106	♀	Yunnan
21927 MCZ	210	188	122	96.0	71.0	60.0	65.0	65.0	118	♂	Szechwan
16492 MCZ	202	184	120	92.0	68.5	59.0	63.0	70.5	114	♀	Szechwan
29956 MCZ	197	184	115	90.0	74.0	63.0	65.0	66.0	115	♂	Szechwan

Nomenclature.—Notwithstanding that Pocock believed the gray and the brown gorals of the Himalayan region to represent distinct species, it seems hardly open to doubt that they are really the same, and that the various named "species," except perhaps some of the island forms, are really referable to a single specific type. The oldest name given to a member of the group is, as Pocock has shown, *Antilope goral* of Hardwicke, 1825, which applies to the gray Himalayan animal. Milne-Edwards in his "Recherches" uses the name *Antilope caudata*, which he had previously bestowed on the goral of the Bureja Mountains, to include specimens sent to the Paris Museum from the mountains north of Peiping. Whether or not the two are really the same seems still to be proved. Heude gave the name *Kemas raddeanus* (1894b) to the goral of the Ussuri region, Manchuria, but it is highly probable that this is synonymous with *N. g. caudatus*, although A. B. Howell (1929) writes of two skins in the U. S. National Museum from Imienpo, Manchuria, that they are "easily

distinguished by the dirty whitish instead of black tail tip, the greater extent of black upon the fore legs, and by the heavier pelage," but these points are doubtless subject to more or less variation. The same author, following Milne-Edwards, refers skins from northern Shansi, Shensi and northern Szechwan to *N. caudatus*, in which he is probably right. Pocock concludes that specimens from parts of western China are hardly different from *K. raddeanus*, and it is true that all the races are extremely alike, after making due allowance for variation of an individual or seasonal nature. Of the fifteen new names given to Chinese gorals by Heude, two, *Kemas galeanus* and *K. vidianus*, were based on specimens from the mountains of Yu Ho, southern Shensi, and are perhaps to be reckoned among the synonyms of this race.

Occurrence and Habits.—It must be admitted that the division of the gorals into geographic races is difficult for they show few definite characters when series are compared. The animal found in northern China is provisionally referred to the same race, *N. g. caudatus*, as that of the Bureja Mountains, representing nearly the northern limit of the range of the genus. It averages slightly paler, with a longer under-wool in winter pelage, and has the gray of the back extending well on to the base of the tail, as compared with other races to the south. Milne-Edwards, writing about 1870, stated that the goral was common on the rocky mountains to the north of Peiping, and it is still apparently found there in some numbers, for Sowerby, who devotes a chapter to it in his book on "Fur and Feather in North China" (1914), writes that it is found as near that city as the peaks surrounding Nankow Pass as well as in the mountains to the westward and for "a considerable distance southward." Where suitable situations occur in northern Shansi, it is also present, occasionally in some numbers in spite of persistent hunting, and inhabits the same country as the Wild Sheep. Possibly the animal of southern Shensi is close enough to this race to be considered the same. Sowerby (Clark and Sowerby, 1912, p. 175) mentions it as inhabiting the highest and most precipitous peaks of the range south of Sianfu, and he secured a male near Liutsun at 4,000 feet altitude. No doubt at one time the range was more or less continuous over northern China, although the southern Shensi gorals have been regarded by Heude as distinct. Of the difficulties of hunting it, the dangerous nature of the cliffs, its haunts, its wariness, and agility in dashing away when pursued, Sowerby has given a graphic account. It feeds, he writes, in the morning and late evenings, often before and after daylight. "After the morning meal, it clambers down to the stream-bed to get a drink, and then hurries back to the cliffs. Here it chooses a sunny spot, often on some spur or ledge of rock in full view of the passer by, and lies down to rest. In summer it prefers the shade of the caves and overhanging rocks. . . . so perfectly does it resemble its surroundings, and so still does it lie, that it is absolutely invisible, even to the

keen eyed natives." The goral is usually hunted by driving, and is found generally singly, or two may be started together, but in its habits it is chiefly solitary, like the serow. The native name is "shan yang" or Mountain Goat. Dr. R. C. Andrews secured three in the Imperial Hunting Grounds near Tungling, northeast of Peiping, in 1919.

I have come upon no records for northern Kansu. Lydekker (1913), however, records a specimen in the British Museum consisting of the skeleton, said to have been collected in the Kentai Mountains of northern Mongolia by Messrs. Dörries, but this western record seems possibly open to question.

Specimens examined.—The following nine are referred to this race:

Hopei: Tungling (Eastern Tombs), 3.

Shansi: Kweihwacheng, 2; Maitaichao, forty-five miles east of Paotowchen, 4.

504. *Næmorhedus goral arnouxianus* (Heude)

SOUTH CHINA GORAL

Kemas arnouxianus Heude, Mém. concern. l'Hist. Nat. de l'Emp. Chin., vol. 2, pt. 1, p. 3, footnote, 1888; *ibid.*, vol. 2, pt. 4, p. 239, pl. 34, 1894.

Kemas henryanus Henry, Proc. Zool. Soc. London, 1890, p. 93. Heude, Mém. concern. l'Hist. Nat. de l'Emp. Chin., vol. 2, pt. 4, p. 244, 1894. Ichang.

Kemas aldridgeanus Heude, *ibid.*, p. 244. Hupeh.

Kemas fantozatianus Heude, *ibid.*, p. 245. Hupeh, middle Han.

Nemorhedus henryanus and *arnouxianus* Sowerby, Proc. Zool. Soc. London, 1917, p. 25.

Næmorhedus goral henryanus G. M. Allen, Amer. Mus. Novitates, no. 410, p. 8, 1930.

Type specimen.—The type is a skin and skull from Kih sien, Chekiang, China, collected about 1888, and is in the Sikawei Museum, Shanghai, where it was examined by Sowerby (1917).

Description.—The general dark-brownish tone of the body extends to the sides, belly, chin and lower throat, where it encroaches considerably on the throat-patch as compared with *N. g. caudatus* and *N. g. griseus*. The throat itself in all the Hupeh specimens examined is uniformly pale orange instead of being whitish with an ochraceous border, and Heude describes a similar condition in specimens from Chekiang. A winter skin (late March) from Fukien is a rich dark shade, due to the abundance of blackish-tipped hairs over the body. The throat-patch is whitish in the center, but is bordered with deep ochraceous; the lower part of the legs is also deep ochraceous. There is therefore some variation in the throat-patch, whether whitish or pale orange, but the border at least, in the former case, is of a deeper shade than in the other Chinese races.

Measurements.—Three adults from the neighborhood of Ichang, topotypes of "*henryanus*," were measured in the flesh by the collector, W. R. Zappey, as follows:

No.	Total length	Tail	Hind foot	Height at shoulder	Height at hip	Sex
17348 MCZ	1210	135	280	680	640	♂
17349 MCZ	1250	115	285	620	600	♀
16493 MCZ	1210	140	288	610	600	♂

For cranial measurements of Hupeh specimens, see table under *N. g. caudatus*.

Nomenclature.—In a previous paper (1930) I used the subspecific name *henryanus* for the goral of Hupeh and Fukien, since the former province, near Ichang, is the type locality. It seems evident, however, from Heude's description of the Chekiang goral, that it is probably the same, with a brighter tint of orange ochraceous on the border of the white throat-patch, or suffusing it, so that probably the earlier name *K. arnouxianus* based on this animal should be used to cover the race of eastern China from the Yangtze Gorges eastward and southward. Two other names, *Kemas aldridgeanus* and *K. fantozatianus*, given later by Heude to gorals from the Ichang region are also to be included in the synonymy. Exactly where and how intergradation with the race to the north, *N. g. caudatus*, takes place is yet to be made out, but possibly those of southern Shensi, Tsingling Mountains, are intermediate, as hinted by Thomas.

Occurrence and Habits.—At the present time the distribution of the goral in eastern China is probably more or less discontinuous, but may once have been more general before hunting and deforestation eliminated it from all but the rougher country. Caldwell does not mention seeing it in his hunting trip to the high mountains near Tunglu in Chekiang, where serow were obtained. Heude in 1888 had apparently but a single specimen on which to base the name *K. arnouxianus*, this having been obtained near Kih sien. I have found no more recent record of gorals in the province, though doubtless they are still to be found. Caldwell obtained an imperfect skin from near Yenping, where apparently the animal is rare. Mr. Clifford H. Pope, while collecting near Kuatun in northeastern Fukien, had repeated reports of the presence of the "chang-tze" from the surrounding mountains but was unable to secure a specimen during his stay. The natives snare them as they do the serow, for the bones of the animal bring a good price for use as "medicine." Small numbers probably still occur in the mountains, even as far south as Kwangtung, for Mell (1922) mentions one that was killed in the limestone hills of that province near Yingdak, and had reports of what was probably the same species from the rough, wooded mountains of the divide between the East and North Rivers (Tsungfah and Lungmunka). Farther westward, it is not uncommon along the Yangtze Gorges in Hupeh, and no doubt is found in the little-known

country to the south and east. E. H. Wilson (1913, vol. 2, p. 149) has recounted his experiences with W. R. Zappey in finding gorals in the former region, for the limestone cliffs along the river are so steep here as to be almost inaccessible to anything but these sure-footed animals. In the Gorge itself they are fairly common and may even be seen from the steamer deck as one goes up the river. According to native report they are found here at altitudes up to about 7,000 feet. A favored locality is the vicinity of Kuanpao in Changyanghsien, four days' journey southwest of Ichang. The Chinese usually take them in snares set in their runways, or by hunting along narrow ravines, where the hunter is stationed on one side, while beaters with shouts and stones drive out any that may be hidden on the opposite side, giving the hunter a shot as they skulk through thickets and emerge briefly along ledges or on the bare cliffs. As elsewhere they feed in the early morning and evening and rest during the day. When alarmed they make a "curious, rather penetrating hissing noise," which, in early April at any rate, may be often heard when in their haunts. They are apparently somewhat less solitary than the serow, two being sometimes started together, while occasionally several may be found in company. They come lower down in winter, but do not enter timber, keeping instead to the scrub-clad cliff country. Nothing seems to be recorded of the breeding habits.

Specimens examined.—The following seven are referred to this race:

Fukien: Yenping, 1 (skin).

Hupei: near Ichang, 4 (M.C.Z.); Patunghsien, 1 (M.C.Z.); Yangtze Gorges, skull (M.C.Z.).

505. *Nemorhedus goral griseus* Milne-Edwards

WEST CHINA GORAL

Nemorhedus griseus Milne-Edwards, in David, Nouv. Arch. Mus. d'Hist. Nat. Paris, vol. 7, Bull., p. 93, footnote, 1871.

Antilope (*Nemorhedus*) *grisea* Milne-Edwards, Recherches pour servir à l'Hist. Nat. des Mammifères, p. 361, pl. 71, fig. 2; pl. 71a, fig. 1, 1868-74.

Antilope (*Nemorhedus*) *cinerea* Milne-Edwards, *ibid.*, p. 362, pl. 70; pl. 71, fig. 1; pl. 71a, fig. 2. Muping, Szechwan.

Kemas niger Heude, Mém. concern. l'Hist. Nat. de l'Emp. Chin., vol. 2, pt. 4, p. 241, 1894. Chenkouting, northeast Szechwan.

Kemas fargesianus Heude, *ibid.*, p. 241. Chenkouting, Szechwan.

Kemas xanthodeiros Heude, *ibid.*, p. 243. Western Szechwan.

Kemas iodinus Heude, *ibid.*, p. 243. Eastern Szechwan.

Kemas pinchonianus Heude, *ibid.*, p. 243. Western Szechwan.

Kemas initialis Heude, *ibid.*, p. 244. Chenkouting, Szechwan.

Kemas curvicornis Heude, *ibid.*, p. 244. Chenkouting, Szechwan.

Kemas versicolor Heude, *ibid.*, p. 244. Chenkouting, Szechwan.

Urotragus cinereus Lydekker, Great and Small Game of India, Burma, and Tibet, p. 139, 1900.

Urotragus griseus Lydekker, *ibid.*, p. 140.

Nemorhedus griseus Pocock, Proc. Zool. Soc. London, 1908, p. 201.

Nemorhedus cinereus Thomas, Proc. Zool. Soc. London, 1912, p. 141.

Nemorhedus goral griseus G. M. Allen, Amer. Mus. Novitates, no. 410, p. 8, 1930.

Type specimen.—The type was not specified by number, but is doubtless the one figured by Milne-Edwards in the "Recherches" and presumably still in the Paris Museum whither it was sent by Père Armand David from Muping, central Szechwan, about 1870.

Description.—The goral of western China is very little different from *N. g. caudatus* of North China. The main external characters are the slightly darker, less gray color, and possibly the shorter winter coat. In a series of twenty skins from southwestern Yunnan, the throat-patch is uniformly whitish, with narrow, pale-ochraceous border, and extends nearly to the lips; the chin is dusky, the flanks and belly pale buffy gray. The base of the tail is usually dark brown instead of gray like the back. Elsewhere the general color of the upper side is much as in the race *N. g. caudatus*.

The chief differences observable in the skulls are the slightly shorter tooth rows and shorter, finer muzzle than in the eastern races, but there is so much individual variation that it is not possible to draw sharp distinctions, and it is difficult to find a satisfactory means of identifying specimens in all cases.

Measurements.—General external measurements are not appreciably different from those of other Chinese races. An adult female from Wa Shan, Szechwan, was measured by Zappey as follows: total length, 1,300 mm.; tail, 115; hind foot, 285; height at shoulder, 642; height at hip, 615. It was the largest of the specimens he secured and is now in the Museum of Comparative Zoölogy. The following measurements were made by Dr. R. C. Andrews and Edmund Heller of specimens they obtained in southwestern Yunnan:

No.	Head and body	Tail	Hind foot	Ear	Sex	Locality
43004	1000	130	280	140	♂	Yunnan
43006	1000	130	280	120	♀	Yunnan
43013	1050	135	270	117	♂	Yunnan
43014	1000	140	270	123	♀	Yunnan
43028	1020	150	265	122	♀	Yunnan
43030	1060	140	275	125	♀	Yunnan
43031	1020	130	260	123	♂	Yunnan
43033	1030	150	270	125	♂	Yunnan
43034	1000	130	280	120	♀	Yunnan

Milne-Edwards supposed that the tail of his North China specimens was longer than that of the Muping animal, but this was doubtless a mistake, due perhaps to measuring the terminal tuft of hair instead of the tail vertebræ.

Nomenclature.—There is very little difference between the goral of the Chinese highlands of Szechwan and that of northern China. On the average, however, the latter is slightly grayer, and the tooth rows shorter, and may be

regarded as a slightly differentiated race. Milne-Edwards's *Antilope cinerea* was from the same region, Muping, as his *N. griseus*, and was believed by him to be more ashy in color, less mixed with brown. This difference is, however, purely individual, for browner examples occur with the grayer throughout the range. Sowerby (1917) has reviewed the many names bestowed by Heude upon Chinese gorals, and finds from an examination of the types in the Sikawei Museum, Shanghai, that no fewer than seven of them were based on specimens from Szechwan. There can be no doubt that all are synonyms, as now generally recognized, although Sowerby inclines to the view that possibly the specimens from northwestern Hupeh, Shensi, and northeastern Szechwan are so similar in their "thin smallish horns and general shape and size" of skull that they can be distinguished from Muping skulls representing *N. g. griseus*. Two skulls from Muping differ from others in being "heavier and larger with a wider forehead, while the horns were narrower and more closely set together." These were regarded by Heude as representing Milne-Edwards's *A. (N.) cinerea*, which was believed by David to live at higher altitudes than *N. griseus*, but the evidence as to its distinctness seems wanting.

Occurrence and Habits.—It appears to be a more or less arbitrary matter where to draw the line between the races *N. g. caudatus* and *N. g. griseus*, perhaps in part because no specimens of the former from the type locality in the Bureja Mountains have been available to anyone for comparison with topotypes of the latter from Muping. Thus A. B. Howell (1929) says of three skins from Shansi, Shensi, and Szechwan, that they "show such a mixture and intergradation of the characters that are usually assigned to *caudatus* and *griseus*" that he would provisionally place them all under the former, as the older name. In any case the differences are slight, and since Muping is the type locality for *N. g. griseus*, it may be assumed that the animals from central Szechwan southward into Yunnan represent it. Over all this area, E. H. Wilson writes that goral are probably common "to all the precipitous country between 1,000 and 8,000 feet from western Hupeh, through western Szechwan and southwards to Burmah." Apparently it is not known whether it occurs in Kweichow. Dr. R. C. Andrews hunted it in western Yunnan and obtained a number from Likiang and south to Tengyueh. He has given an excellent account of hunting the goral in the high mountains of this part of Yunnan and describes the rough craggy country in which they live. "Their color made them practically invisible against the rocks and when I killed the second goral my only distinct impression as he dashed down the face of a precipice, was of four yellowish legs entirely separated from a body which I could hardly see. . . . This invisibility, combined with the fact that the Snow Mountain gorals lived on almost inaccessible cliffs thickly covered with

scrub spruce forest, made 'still hunting' impossible." At Liuyang, below Tatsienlu, W. R. Zappey once killed two with a single shot, his bullet passing through the neck of one and through the body of the other. He had seen only one when he fired, but both dropped stone dead!

Specimens examined:—The following twenty-five:

Szechwan: Wa Shan, 1 (M.C.Z.); Liuyang, 1 (M.C.Z.); Batang, 1 (M.C.Z.).

Yunnan: Likiang, 7; Hsiaokela, 1; Tengyueh, 14.

Genus **Budorcas** Hodgson

TAKIN

Budorcas Hodgson, Journ. Asiatic Soc. Bengal, vol. 19, p. 65, pls. 1-3, 1850. Pocock, Proc. Zool. Soc. London, for 1910, p. 856, 1911; Ann. Mag. Nat. Hist., ser. 9, vol. 2, p. 136, 1918.

The takin is characterized by its heavy, almost clumsy build, especially of the fore legs, which are stout, with relatively short cannon-bones, and the shoulder height is greater than that at the hips. The horns are of peculiar shape, arising from a bony elevation at the summit of the skull, curving slightly upward and outward, then backward, hooking slightly inward toward the tips. Their bases are transversely ribbed. The muzzle is thick and broad, expanding into a sort of muffle; the nostrils open into a wide naked area of skin, which extends below them narrowly to the edge of the upper lip. There is no suborbital gland, nor are there foot glands present. The tail is relatively short and there is a slight beard. Pocock (1918) has figured the rhinarium and mammary glands (of which there are four) in a male and describes the structure of the penis as very like that of *Næmorhedus* except for the greater elongation of the free portion of the urethral canal. Pocock (1918) has concluded that the relationship of *Budorcas* to *Ovibos* advocated by Lönnberg is not very close, but that the latter might, in a conservative view, be included within the Rupicaprinæ.

The skull differs in many minor characters from those of the other Asiatic members of the subfamily, conspicuous among which is the great inflation of the muzzle, the length of the premaxillæ, the shortness of the nasals, the markedly protruding orbits and the bony summit from which the horns come off. The upper molar teeth are broad but show no supplementary enamel column at the entrance to the median valley, while the outer face of both premolars and molars is rather smooth, with the thickened columns at the corners only slightly prominent. On account of the great depth of the rostrum, the upper profile of the face is nearly parallel with the alveolar row, instead of forming a sharp angle with it as in the genera *Capricornis* and *Næmorhedus*. In correlation with the absence of suborbital glands, there is no pit in the lachrymal, but the bone has a flat surface, except where it turns

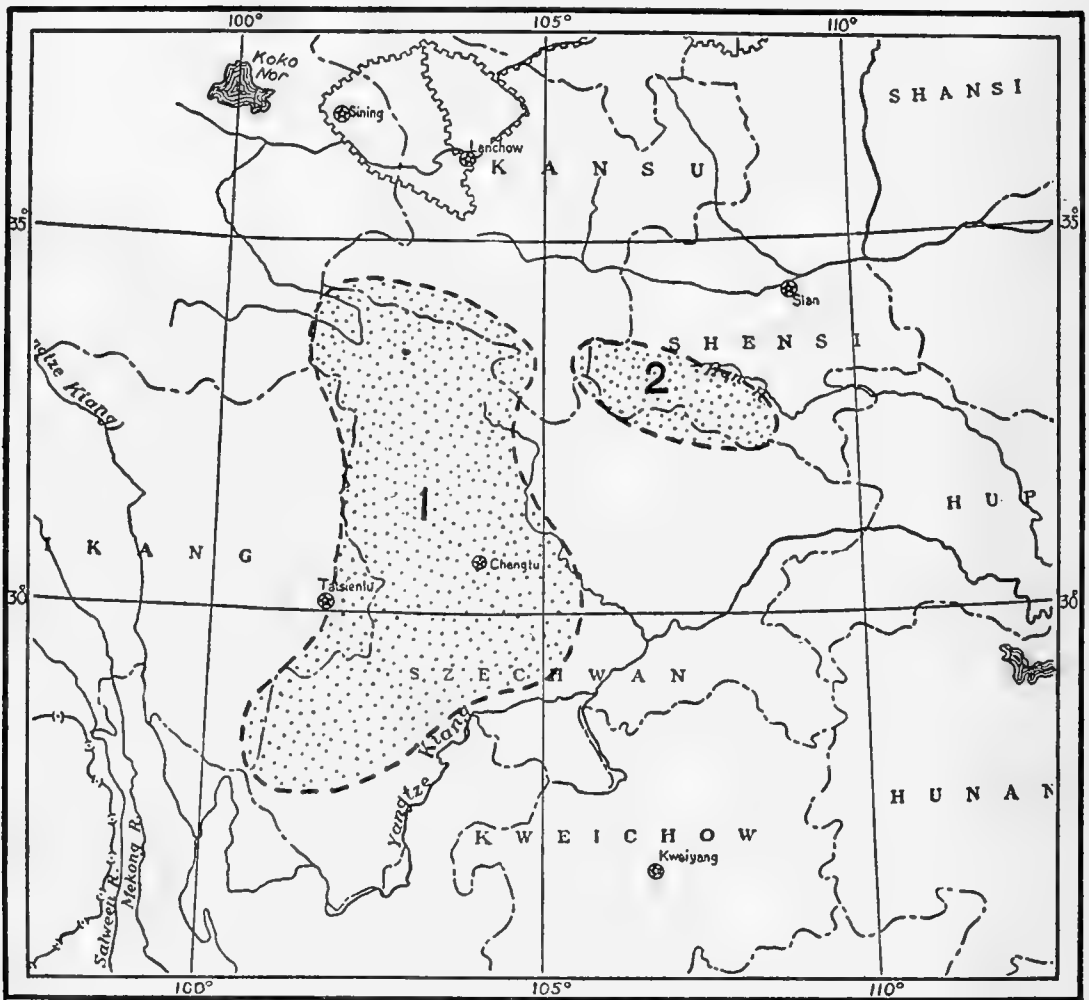


FIG. 71. Distribution Map.
Budorcas

1. *B. taxicolor tibetana*

2. *B. taxicolor bedfordi*

outward to form the anterior part of the projecting orbit. The tips of the premaxillæ are very widely separated from the short nasals, but the upper corners of the maxillaries nearly touch them, and the anterior corner of the lachrymal is barely in contact with the middle of the lower edge of the nasal. The nasals are supported chiefly or wholly by the frontals, and are produced back medially into a deep V-shaped notch for their reception. The turbinal bones, especially the maxillo-turbinals, are very large and strongly ossified.

The takin is peculiar to the higher levels of the eastern Himalayas of Bhutan and the Mishmi Hills, eastward across Yunnan and Szechwan to the borders of Kansu and southern Shensi. Its pelage in the western part of the range is dark, but becomes progressively lighter toward the east, until in the

Shensi animal it is nearly yellowish white all over, showing thus a tendency to approach the all-white condition seen in the American representative of the rupicaprine section, *Oreamnos*. Two races are found in China, which may be known by the following key:

KEY TO CHINESE RACES OF *Budorcas*

- A. Muzzle dark, a dark ring about the eye, and a dark dorsal stripe. . . . *B. taxicolor tibetana*
 B. Whole face orange yellow, dorsal stripe usually absent. *B. taxicolor bedfordi*

506. *Budorcas taxicolor tibetana* Milne-Edwards

SZECHWAN TAKIN

Budorcas taxicola var. *tibetana* Milne-Edwards, Recherches pour servir à l'Hist. Nat. des Mammifères, p. 367, pls. 74-79, 1868-74.

Budorcas taxicolor sinensis Berezovski, MS., in Ward, Records of Big Game, ed. 5, p. 350, 1907. Substitute for *tibetana*.

Budorcas taxicolor mitchelli Lydekker, The Field (London), vol. 111, p. 790, 1908; Proc. Zool. Soc. London, for 1908, p. 795, 1909. Tatsienlu, Szechwan.

Budorcas sinensis Lydekker, Proc. Zool. Soc. London, for 1908, p. 795, 1909.

Budorcas tibetanus Lydekker, *ibid.*, p. 797, pl. 43.

Budorcas tibetana Lydekker, Cat. Ungulate Mamm. Brit. Mus., vol. 1, p. 214, 1913.

Type specimens.—Milne-Edwards based his description of this race upon a series representing male, female and young examples, but how many and what their numbers he does not say. His original series sent from Muping, Szechwan, China, by Père Armand David to the Paris Museum, therefore consists of cotypes. They were probably collected about 1872 and comprised, in some cases at least, portions of the skeletons as well as the skins.

Description.—In contrast to the dark brown color of the Himalayan takin, that of Szechwan is usually paler. A specimen from Wa Shan is colored as follows: The edge of the upper as well as the lower lip in the middle, white. Upper lip and side of the muzzle back to the corner of the mouth, black, which is continued back on the side of the muzzle half-way to the eye, becoming mixed with whitish and then passing into buffy white on the rest of the head, neck, and withers, to the elbow, except that a broken ring of black surrounds the eye, not sharply marked on account of the mixture of the black with white hairs. Backs of the ears black and white, the latter predominating near the base, the former at the distal part where it is only slightly mixed with white. Inside of the ears white, except for a mixture of black near the outer edge of the second third. Back of the withers, the entire body becomes clouded with black to the heel and base of the tail, clearer on the edges of the buttocks. The fore foot from the "knee" to the hoof is black in front and white posteriorly, while the hind foot from the heel to the hoof is similarly black, with a whitish patch on each side just above the lateral hoofs. The short tail is mixed whitish and black at the base, black at its tip where the longer hairs make a short tuft.

Milne-Edwards's figure agrees essentially with this description, except that he does not show the blackish eye-ring. The general tone of the coat is often more yellow, varying to reddish gray.

Probably there will eventually be found to be a wider range of variation in color. The young were described by Milne-Edwards as reddish brown with a blackish mid-dorsal line and a blackish mixture on the cheeks and belly. This is essentially as in two young calves secured by Zappey in Szechwan. The color of the young is apparently the same in the Himalayan race, its progressive lightening in the Chinese races being then a derived condition.

In the skull the nasal bones are separated proximally by a V-shaped prolongation of the frontals, instead of being nearly straight across as in *Capri-cornis* and *Nemorhedus*.

Measurements:—In size this race probably does not differ from the race *B. t. bedfordi*, for which Wallace's and other measurements are quoted. Milne-Edwards (1868-74, p. 375) tabulates a number of dimensions of the male sent to Paris by Père David, but it is likely that these were taken from the animal as mounted. The more important are: total length from end of muzzle to base of tail following the curves of the body, 2,130 mm.; length of trunk in a straight line front of breast to anus, 1,160; height at shoulder, 1,020; ear, 110; length of horns following their front curve, 480.

Cranial measurements of the two Chinese races are given in the table following.

CRANIAL MEASUREMENTS OF *BUDORCAS*

No.	Condy- lo- basal length	Basal length	Pala- tal length	Great- est length of nasals	Breadth of nasals	Orbit to muzzle	Zygo- matic width	Mas- toid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Locality
<i>B. taxicolor tibetana</i>												
8009 MCZ	373	360	230	130	52	236	172	130	111	119.0	125	Szechwan
<i>B. taxicolor bedfordi</i>												
57013	379	357	238	129	58	240	163	126	115	115.0	121	Shensi
57014	362	341	225	131	55	230	158	124	108	121.5	128	Shensi
57017	384	365	243	126	58	252	169	126	118	110.0	119	Shensi

The longest horns of this race recorded in "Rowland Ward's Records of Big Game" (9th edition, 1928) are those from Szechwan secured for the Paris Museum by Père David, measuring $19\frac{3}{8}$ inches (500 mm.) in length on the front curve, $11\frac{1}{2}$ inches (292 mm.) in circumference, and $13\frac{3}{8}$ inches (340 mm.) between the tips. A second pair taken by M. Mitchell near Tatsienlu, Szechwan (Hsikang), is only seven-eighths of an inch less in greatest length and measures 16 inches (405 mm.) from tip to tip. Both these specimens are

inferior to one recorded by E. H. Wilson (1913, vol. 2, p. 158), purchased by him near Wa Shan, Szechwan, which measured $20\frac{3}{4}$ and 20 inches (528 and 510 mm.), with an outside spread of $16\frac{3}{8}$ inches, and was the largest pair he had seen in much traveling in China. He estimates the weight of a full-grown animal as about 500-600 pounds.

Nomenclature.—The name *B. t. tibetana*, given to this race by Milne-Edwards, seems to have been thought inappropriate by Berezovski, since the original locality is no longer regarded as part of Tibet, hence he suggested the substitute *B. t. sinensis*, a suggestion at one time adopted by Lydekker but later given up as inadmissible. Lydekker later (1908e, p. 790) named the grayer phase *Budorcas t. mitchelli*, believing it represented a different race from the yellower phase of the same animal. This name, based on a specimen from Tatsienlu, is thus a synonym of *B. t. tibetana*. He later reached the conclusion that this difference was a sexual one, and that the males attained the rich golden-yellow hue, while the females were characterized by the gray or mixed whitish and black color. Jacobi (1922), however, describes a female from Szechwan as having the head pale straw-color, darkening ventrally, the nose and chin black, eye-ring and ear black, mixed with yellow; back yellowish gray, mixed with blackish on the flanks and with a black dorsal stripe from the withers to base of tail, widely bordered with dark brown. Legs mixed black and yellowish gray. It has been suggested that the gray pelage is characteristic of winter, but more likely it is a matter of age.

Occurrence and Habits.—Previous to Père Armand David's famous journey into Muping, the takin was almost unknown to naturalists, the brief accounts of Hodgson supplemented by two imperfect skins in the museums of England furnishing almost the only details available, and these were of Indian origin. David not only substantiated the animals' presence in western China but sent back to Paris skins and skeletons of several individuals representing various ages, so that Milne-Edwards was able to give a detailed account of the characters. During the interval from the time of his visit about 1870 till the end of the century, no other specimens seem to have been obtained by Europeans, nor is it known, apparently, whether David obtained his specimens from the native hunters or actually killed them himself. The former alternative is usually assumed, so that credit for being the first white man actually to kill a takin is given by E. H. Wilson (1913) to Walter R. Zappey, who accompanied him on an expedition to western China in 1908, and shot his first takin on May 27 of that year, only a few days before Mr. C. H. Meares, an Englishman, killed one, while in August following, Major Malcolm M'Neill, hunting in Yutung, "happened on a herd in open country, and killed several."

Accounts of hunting takin have been published by E. H. Wilson (1913),

W. N. Fergusson (1911), and in Kansu by Wallace (1913). Fergusson describes the haunts of the takin as he saw them in the Wassu country and the Changmin district, slightly to the northeast of Muping. He writes that in the winter season the animals come down off the upper levels to sheltered valleys, and in the spring migrate upward again to the grassy plains where they spend the summer near and above tree-line. In the exceedingly rough country of these high mountains, takin are to be found at elevations of between 8,000 and 14,000 feet in dense thickets of rhododendron and dwarf bamboos near the upper limit of tree growth. The animals break out narrow trails through this thick undergrowth and use them regularly in their passage to and from grazing areas and salt licks. E. H. Wilson (1913, vol. 2, p. 156) gives an excellent account of the native methods of its capture by the use of deadfalls or the spear-trap, which is tripped off by the takin in passing along the path, releasing a spear or knife fixed to the end of a heavy beam which comes down upon the victim from above with such force as to drive the blade almost through the animal's body behind the shoulder. "Around Wa Shan the Takin is killed by an arrow shot from a cross-bow fixed by hunters alongside the run or by an ingenious gun device. It is also captured by cunningly arranged foot-snares" (E. H. Wilson, 1913). The natives hunt the takin for its flesh which is much esteemed by them, although Wilson regards it as decidedly inferior, though better than that of the serow. He writes that the native name is everywhere "yeh niu," equivalent to Wild Cattle or Wild Ox.

The range of the takin in western China includes the high country from south of Tatsienlu northward more or less continuously to the borders of southern Kansu and thence eastward to the Tsingling Range. In the latter area it is slightly paler, lacking the black eye-ring, and acquiring a more golden tint, the race *B. t. bedfordi*, but exactly where or how intergradation takes place has not been worked out. Probably typical *B. t. tibetana* extends to Kansu and northeastern Szechwan, and for the present the race *B. t. bedfordi* is assumed to be more or less restricted to Shensi. "In certain places, like the wild country between Lungan Fu and Sungpan, the Panlan range, and in the petty state of Yutung, it may be said to be common. Anywhere in these regions where there are 'salt-licks' this animal is to be found. In western Szechwan its eastern limits are the high ranges forming the western boundary of the Red Basin" (E. H. Wilson, 1913, vol. 2, p. 155). There seems to be no evidence of its presence in Yunnan, although it may yet be found in the high mountains of the southwestern part. It would seem as if the great bend of the Yangtze formed nearly the southern boundary of the area to which this race is confined at the present time, and that its range is not quite continuous with that of the race in the mountains of Nepal and Bhutan to the westward, typical *B. taxicolor*.

From the accounts of those who have hunted them, a number of interesting points in the life history of the takin may be gleaned. Wilson and others find that they spend the daytime in the thickets of rhododendron and bamboo near the timber line, emerging in late evening as well as in the early morning to graze on the grassy slopes near at hand above them, or in cloudy or foggy weather they may remain in the open throughout the day. The rutting season is said to be in late July, and the young are born in the following March. The cow killed by Zappey on September 17, 1908, contained a fetus "about the size of an ordinary squirrel," while on the previous May 27 he had shot two small calves accompanying their mother, but the latter made off through the jungle and escaped. These young were said by the natives to be about two months old, and although about 22.5 inches high at the shoulder, showed no sign of budding horns. The old bulls are said to be found usually living alone, but during August and early September "cows and young bulls are found severally together" (Wilson). In spring the young calves follow their mother about and can accompany her anywhere three days after birth. In the early spring the takin "seem to feed almost entirely on a plant which looks very much like rhubarb or burdock and grows along the bottoms of valleys. In the month of June they all collect about the salt licks, toward which they make broad, regular, beaten roads, and a little later collect into large herds, and graze in the grass lands above the tree-level." These herds are said to be led by an old bull which they follow everywhere. The natives with inferior weapons are much afraid of them at this time, and say that if one of the group is wounded the entire herd will charge right over the hunter (Fergusson, 1911), but this may perhaps be on occasions when they are frightened and are merely dashing to cover in their familiar thickets. According to Wallace, however, they will often, when started, run for only a short distance and then resume feeding, but this may apply mostly to localities where they have been less disturbed.

Lydekker (1913, p. 215) notes that he has in his possession horns supposed to have come from Yunnan, but does not appear himself to give much weight to this evidence.

Specimens examined.—The following three:

Szechwan: Lianghokow, 1 (M.C.Z.); Wa Shan, 2 young (M.C.Z.).

507. *Budorcas taxicolor bedfordi* Thomas

SHENSI TAKIN

Budorcas bedfordi Thomas, Abstract Proc. Zool. Soc. London, May 2, 1911, p. 27; Proc. Zool. Soc. London, 1911, p. 693, pl. 29. Lydekker, Cat. Ungulate Mamm. Brit. Mus., vol. 1, p. 217, 1913.

Budorcas taxicolor tibetanus J. A. Allen, Bull. Amer. Mus. Nat. Hist., vol. 26, p. 425, 1909 (not of Milne-Edwards).

Budorcas taxicolor bedfordi G. M. Allen, Amer. Mus. Novitates, no. 410, p. 9, 1930.

Type specimen.—An adult female, skin and skull, No. 11.6.1.64, British

Museum, from Taipai Shan, 10,000 feet altitude, southern Shensi, China. Collected January 15, 1910, by Malcolm P. Anderson.

Description.—Typically this northeastern race of takin shows the extreme of lightening of color, already exemplified by the Szechwan animal, through the greater suppression of the black element in the pelage. Lydekker describes the color as of a general golden buff, tending to ochery in males and to creamy in females, without dark markings on face or back. Scattered dark hairs may be present in the feet and tail tip.

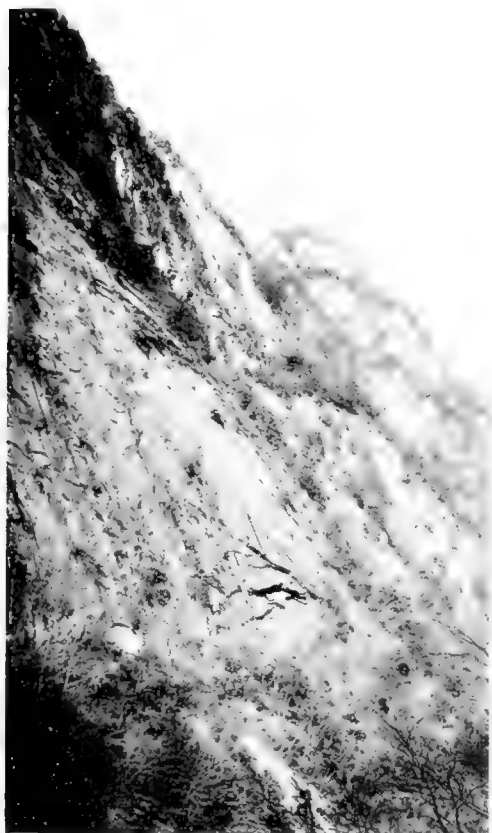
An adult female topotype killed in November, 1921, has the long, shining, coarse coat, white with a faint buffy tint becoming deeper and more golden on the sides of the neck, the chest, and the metapodials, whereas on the tail, the tint may be even rusty. The muzzle retains a little dark hair mixed with the buffy, but none elsewhere except for a very little about the base of the hind hoofs and a few scattered black hairs in the midline of the back. There is a short fine wool at the base of the long hair (No. 57014). Another and somewhat younger female (No. 57015), likewise from Taipai Shan, has the muzzle from in front of the eyes to the nostrils dark brownish black, passing into buff on the forehead, and with a few dark hairs on the chin. The backs of the ears are mixed blackish and white, their inside buffy centrally, grizzled at the edges. A well-defined dorsal stripe of blackish to dark brown begins at the occiput and passes back to include the tail. Lips and sides of neck white, throat buffy, as well as a narrow strip on each side of the black mid-dorsal line. Fore and hind legs mixed gray and black, the elbow area darkest; flanks paler, grayish. Belly and inside of hind legs white tinged with buffy or brownish. A few longer black hairs about the eye, but no black eye-ring.

In two other adult females the color is quite as in the first one mentioned, but the rusty tint of the tail and anal region is even deeper, the sides of the neck more golden; in a fourth the tail is dark rusty brown, while a few longer black hairs form an ill-defined spot just below the eye.

This series of five female topotypes indicates that the absence of a black muzzle and eye-ring, as well as the lack of a mid-dorsal black line and the lighter color of the feet, are characters separating this northeastern race from the darker *B. t. tibetana* to the southwest, while the immature female is so similar to the latter that it is only in the adult pelage that the races can be distinguished.

The skull is practically the same in both, except that in those examined, *B. t. bedfordi* has the muzzle less bowed out in the middle, making it 4-12 mm. narrower across the middle of the rostrum.

Measurements.—As with the race *B. t. tibetana* and the typical subspecies,



Takin country in the Taipai Shan, Shensi



Dwarf-bamboo thicket in Takin haunt ,
Taipai Shan



A Shensi Takin (*Budorcas taxicolor bedfordi*), killed in the Taipai Shan, Shensi

the males are larger with slightly heavier horns than the females. Wallace (1913) has given the measurements in detail of three takin from the Tsingling Mountains collected by himself and George Fenwick Owen. The most important of these (reduced to millimeters from inches) are as follows:

	Ad. ♂	Ad. ♂	Ad. ♀
Length of body, nose to root of tail.....	1880.0	1803	—
Length of body, following curves.....	2235.0	2083	1681
Tail.....	216.0	178	152
Hind foot from hock to hoof.....	444.5	406	267
Height at shoulder (allowing for weight when standing)	1321.0	1295	1041
Height at hindquarters.....	1232.0	1206	—
Girth behind shoulder.....	1930.0	1524	1422

The total weights of the two above males, allowing 12 pounds for loss of blood and body fluids, were 435 and 665 pounds respectively.

Cranial dimensions of adult female skulls are given in the table under *B. t. tibetana*; probably those of adult males would be slightly larger.

Occurrence and Habits.—The presence of takin in the Tsingling Range of Shensi seems first to have been mentioned in print by Père Armand David (1873) who, in a letter to Consul Robert Swinhoe (published in the Proceedings of the Zoölogical Society of London, 1873), writes of the various mammals which he finds in the mountains not far from Sianfu, south of the Hwang Ho. Here this remarkable collector stayed for three and a half months and made sundry collections. He mentions the lofty peaks, some of them attaining 12,000 feet altitude, and the haunts of *Budorcas* as well as of serow. No further record of the locality in connection with the takin appears until 1909, when Dr. J. A. Allen reported (1909a) on a collection of mammals made at Taipai Shan by collectors working for Alan Owston. Among the specimens were the horns of an adult and the skins of two young takin. Two years later, Oldfield Thomas (1911e) named the race on the basis of a male and two females (one of which became the type) secured on Taipai Shan at about 10,000 feet altitude by Malcolm P. Anderson of the Duke of Bedford's Expedition. The practical lack of any dark markings is characteristic of adults from this region, where the animals seem to be isolated by a distance of some hundreds of miles from the nearest known stations in Kansu. Anderson notes that they were found here in "large herds" in precipitous places at altitudes between 9,000 and 11,000 feet and mentions one herd of about forty head. They feed especially on a small bamboo common there. The next locality to the westward where takin are known to occur is said by Anderson to be Piekow, southern Kansu. It may be that the takin from the latter district are referable to *B. t. bedfordi*, but one would expect them to represent the Szechwan race *B. t. tibetana*, for the range is practically continuous to the southward.

Wallace (1913) has given a splendid account of the haunts and hunting of the Shensi Takin, with original illustrations (photograph and sketches) of the animal. He speaks of the appearance as a conspicuous golden yellow in the sunlight, the females considerably lighter and more silvery in tone than the males. The latter are much the larger, with a decided reddish tinge about the neck. They recalled to his mind the Rocky Mountain Goat in their heavy build and lumbering gait, notwithstanding that they can be very agile. The head is usually carried low, with the point of the muzzle below the level of the back. The young, he writes, are yellowish gray shading to a darker tone, and so perhaps paler than in the Szechwan race, although with a mixture of brown on the flanks. According to native report quoted by Wallace, the calves are black and white in their second year and gradually acquire the yellow coat. In winter they feed on bamboo and willow, in the summer on "birch shoots, a kind of elm, grass and a strong-smelling herb with a yellow flower of which they are very fond," a species of *Senecio*. If alarmed they will descend into the bamboo jungle where they are difficult to approach. Although in winter they break up into small bands, in summer these may collect into considerable herds, but Wallace himself apparently did not see any of very great size. "When suspicious they give each other warning by a kind of hoarse cough, and during the rut [in late July and early August] utter a low bellow." He found the old bulls adepts at hiding if pursued, even lying with outstretched necks in dense thickets and refusing to move until the hunter is almost upon them. On August 6 he mentions coming upon a herd of eight, comprising three bulls (one large and two small), three cows and two calves. "Two of the bulls were sparring while the calves played about among the rocks."

Specimens examined:—Five, topotypes, from Taipai Shan, Shensi.

Genus *Poëphagus* Gray

THE YAK

Poëphagus Gray, List Mammals Brit. Mus., p. 153, 1843 (genus). Lydekker, Cat. Ungulate Mamm. Brit. Mus., vol. 1, p. 30, 1913 (subgenus).

Bos Linnæus, Syst. Nat., ed. 12, vol. 1, p. 99, 1766 (in part).

Bison Jardine, Naturalist's Library, Mammals, vol. 4, p. 259, 1836 (in part).

The Yak is undoubtedly closely related to other cattle, particularly to the tropical members of the genus *Bibos*, the banteng and gaur, in the conformation of the penis which, as pointed out by Lönnberg and by Pocock, "has a short tubular urethral prolongation free from the terminal glandular thickening," which forms a rounded cushion at the end of the organ (see fig. 4, D and E, in Pocock's paper, Ann. Mag. Nat. Hist., ser. 9, vol. 2, p. 454, 1918). This peculiar prolongation is absent in *Bos* as typified by the domestic cattle and the Indian humped cattle. The shape of the rhinarium differs in being much

narrowed just above the lip. Lydekker (1913) regards the Yak as forming a subgenus of *Bos*, and gives the following characters: "horns more or less nearly circular in section, widely separated, on a ridge placed below the extreme vertex of the skull, so that the summit of the crest of the occiput is visible from the front. Forehead short, wide and slightly convex, with a short interval between base of horn-core and orbit. Tail reaching about to the hocks. Withers elevated. A fringe of long hair extending from chin and throat along the lower part of flanks and belly; tail long-haired throughout. Fourteen pairs of ribs; neural spine of seventh cervical vertebra tall; spines of dorsals very tall, descending rapidly and suddenly to the lumbar." The single living species of Yak has been domesticated for a long period in Tibet and the adjacent high country to which it is adapted. It is found in a wild state in these regions at the present day, but to what extent these wild individuals represent feral animals that have descended from domesticated stock is not possible to tell.

508. *Poëphagus grunniens* (Linnæus)

WILD YAK

Bos grunniens Linnæus, Syst. Nat., ed. 12, vol. 1, p. 99, 1766.

Bos poëphagus Pallas, Zoographia Rosso-Asiat., vol. 1, p. 248, 1811.

Bison poëphagus Jardine, Naturalist's Library, Mammals, vol. 4, p. 259, 1836.

Poëphagus grunniens Gray, List. Mamm. Brit. Mus., p. 153, 1843.

Poëphagus mutus Przewalski, Reisen in Tibet, p. 72, 1884.

Bos (Poëphagus) grunniens Huet, Bull. Soc. d'Acclimatation, Paris, vol. 38, p. 334, 1891. Lydekker, Cat.

Ungulate Mamm. Brit. Mus., vol. 1, p. 31, 1913.

Bos grunniens mutus Lydekker, Cat. Ungulate Mamm. Brit. Mus., vol. 1, p. 33, 1913.

Type specimen.—None in existence. The type locality is "in Asia boreali." No doubt, as Lydekker (1913) says, the name is based on the domesticated yak, but this does not seem sufficient ground for making the wild yak a subspecies, using Przewalski's name *P. mutus*, until it can be shown that this is different from domesticated yaks as a geographical race. The name *P. mutus* was given by Przewalski to Tibetan wild yaks.

Description.—The general build is stocky, the body a uniform rich dark reddish brown (near Vandyke brown), becoming blackish brown on the fringe of long and slightly crinkled hair that hangs down on the sides from the level of the lower throat along the flanks to the posterior side of the buttocks below the basal half of the tail, which itself is heavily tufted and blackish. Domesticated individuals may develop white markings of varying extent, but it is apparently normal to have a small amount of white about the muzzle. Old animals may have a "sprinkling of grey on the head and face" (Lydekker).

The skull is heavily built, with a slight transverse elevation on the occiput. Nasals as usual in cattle, broad, the posterior ends tapering to a point

together behind. The lachrymal is narrow but extends far forward along the antero-external corner of the frontal to a wide contact with the basal portion of the outer margin of the nasal. The upper border of the maxillary is in contact with the outer edge of the middle third of the nasal, but the upper end of the premaxillary fails to reach the nasal. The premaxillaries have their outer sides nearly parallel, instead of tapering, with broad, slightly spread tips, and are of rather heavier bone than in cattle generally.

The form of the horns is rather characteristic, with a wide lateral sweep, turning then forward and finally upward and slightly bent inward. They are nearly smooth, with a few low transverse ridges at the base.

Measurements:—No external measurements of Chinese specimens are at hand. Lydekker (1913) gives the shoulder height in adult bulls as $5\frac{1}{2}$ feet (1,675 mm.) or more. The following dimensions are given from Biddulph in "Rowland Ward's Records of Big Game": length from between horns to base of tail, 8 feet 0.5 inches (2,500 mm.); tail, 3 feet 2.5 inches (978 mm.); from between the horns to the nose, 15.5 inches (394 mm.). The weight of this animal was about 1,140 pounds. A still larger male was killed by Schäfer (1937) in the upper Yangtze region of Tibet that measured in total length 3,680 mm., with a height at the shoulder of 2,030 mm.

The horns vary in the details of their curvature, but the longest measurement given in the ninth edition of "Rowland Ward's Records of Big Game" is $38\frac{1}{4}$ inches on the outside curve and 19 inches from tip to tip for a specimen from the Kuenlun Mountains.

For the sake of completeness, the cranial measurements of the two large male wild Yaks collected by Mr. Brooke Dolan in the region of the Chumar branch of the upper Yangtze, in eastern Tibet, are here given.

No.	17310 ANSP	17311 ANSP
Tip of premaxillaries to vertex of skull.....	610.0	576.0
Condylbasal length.....	555.0	540.0
Basal length.....	528.0	506.0
Width across orbits on dorsal surface.....	285.0	240.0
Width across zygomata behind eyes.....	235.0	225.0
Length of nasals.....	255.0	230.0
Combined width of nasals.....	97.5	81.0
Height of occiput, from foramen magnum to vertex.....	230.0	192.0
Width of occipital shield.....	252.0	250.0
Greatest spread of horns.....	810.0	735.0
Distance from tip to tip of horns.....	460.0	210.0
Width outside first molars.....	140.0	136.0
Upper cheek teeth, alveolar row.....	130.0	154.0
Upper molars alone.....	76.0	91.3
Lower cheek teeth, alveolar row.....	140.0	150.0

Occurrence and Habits.—The Yak is doubtless to be regarded as one of the mammalian types peculiar to the Tibetan plateau, adapted to the rigorous climatic conditions of that area by its thick winter coat with a long fringing skirt of hair hanging down from throat to tail, perhaps as a protection from driving snow or against snow and dampness when lying down. A somewhat similar adaptation is seen in the Musk-ox, also an animal of open, windswept country snow-covered during part of the year. The wild Yak was found by Przewalski from the Karakoram eastward along the Kuenlun Mountains of Chinese Turkestan to Altyn Tagh and the Nan Shan Range of extreme western China, becoming less rare in the high valleys of the Nan Shan Range and in Kansu, near the sources of the Etsin Gol and Tatung Gol, but avoiding the Koko Nor basin and the salt steppes of Tsaidam, Chinghai. It occurs also in the eastern part of Tibet about the sources of the Yangtze. Other than this there seems to be no information available as to its presence or habits as a wild species in western China. The Kuenlun, 35° north, seems to be the northern limit of the range in Tibet, but there is no way of telling whether or not the wild Yak is natural to these regions or to other areas where it is now found, for it must frequently be that domesticated stock is turned loose or goes wild. On account of its extreme hardiness it is the usual pack animal of the Tibetans, surviving in country where horses and camels would perish. Radde (1862, p. 272) mentions that Yaks are used by the people of southern Transbaikalia, and often live so independently of man, as along the Mongolian border in the southern Apple Mountains, that they are virtually wild animals. They were used more commonly about fifteen to twenty years before his visit, when herds might number as many as a thousand head, but by 1856 these had greatly diminished.

Specimens examined.—No Chinese examples have been seen.

Genus *Ovis* Linnæus

SHEEP

Ovis Linnæus, Syst. Nat., ed. 10, vol. 1, p. 70, 1758.

Sheep are essentially mountain-living, preferring open rocky country where alpine grasses and sedges form sufficient pasturage. They have wonderful powers of vision and scent, as well as excellent hearing, faculties necessary for existence in such places where watchfulness is the price of life.

Externally the genus *Ovis* is characterized by its rather stocky form, without being coarse and heavy like cattle; the tail is very short, the ears small and well haired, the hoofs short with their anterior slope more nearly vertical, adapting them for rock-climbing. Foot glands are present, opening between the toes. Mammæ two, inguinal. The horns, which are present in

both sexes but much larger in the adult males, usually form in the latter a lateral spiral seldom of more than one and a fraction complete turns. These are heavy at the base, in section somewhat triangular, with the anterior face broadly rounded and the posterior angle sharp; the horn core is similar, with in both an outward twist. The horn sheath is marked by strong ridges going transversely about the main axis. The skull is somewhat triangular as seen from above, with prominent bony orbits, a short, pointed muzzle, ample nasal chamber, with the pointed nasals projecting considerably in front of the point of junction between nasals and premaxillaries. In its posterior part the axis of the cranium forms an obtuse angle with the palate. In adult males the occipital face of the skull is nearly in a vertical plane to give surface for the muscles that support the heavy horns. There is a shallow but well-marked pit in front of the eye for the suborbital gland, a character shared with most of the deer family. The cheek teeth are, as usual in the family, markedly high-crowned, the three premolars short and almost square in section, their combined length less than that of the succeeding molars, of which the first is the shortest, the second longer, the third longest from front to back. The molars are without an accessory column of enamel in the opening of the valley between the inner cusps, while on their external side the anterior corner and the middle of the tooth have a thickened vertical ridge of enamel. In the premolars three such ridges may be traced in the first and second, and the anterior and posterior ridges in the third. The lower incisors and canine have thick spatulate crowns which turn upward instead of nearly straight forward. The genotype is *Ovis aries* Linnæus, the domestic sheep, whose wild prototype is perhaps extinct.

Mountain sheep are characteristically Asiatic, with several different types occurring over the Himalayan region to northeastern Siberia. They are probably late immigrants from the latter area into the western mountains of North America. A single widespread species, *Ovis ammon*, of central Asia extends into the mountainous and semi-desert country of northern China and Mongolia, where it is currently regarded as a subspecies.

509. *Ovis ammon darvini* Przewalski

DARWIN'S SHEEP; ARGALI

Ovis darvini Przewalski, Journey in Tibet, p. 260, 1879-80 (in Russian); Reisen in Tibet, p. 268, text fig., 1884. *Ovis argali mongolica* Severtzov, Trans. Imp. Soc. Nat. Moscow, vol. 8, art. 2, p. 154, 1873 (not *Ovis aries mongolica* Fitzinger, 1860). Mongolia.

Ovis jubata Peters, Monatsb. Kön. Preuss. Akad. Wiss. Berlin, 1876, p. 177, pls. 1-4 (not *Ovis aries jubata* Kerr, 1792; Fitzinger, 1860). Mongolia, north of Peiping.

Ovis ammon jubata Lydekker, Wild Oxen, Sheep and Goats, p. 180, 1898; The Sheep and its Cousins, p. 271, 1912.

Ovis ammon mongolica Lydekker, Cat. Ungulate Mamm. Brit. Mus., vol. 1, p. 96, 1913.

Ovis kozlovi Nasonov, Bull. Acad. Imp. Sci. St. Pétersbourg, ser. 6, vol. 7, pt. 1, p. 621, 1913. Yabaraï Mountains, southern Gobi.

PLATE XVIII



Takin country in the Taipai Shan, Shensi



Sheep and Ibex haunts at Artsa Bogdo, Outer Mongolia

Ovis comosa Hollister, Proc. Biol. Soc. Washington, vol. 32, p. 46, 1919. Substitute for *O. a. mongolica*.

Ovis commosa Sowerby, China Journ. Sci. and Arts, vol. 1, p. 79, 1923; *ibid.*, vol. 2, pp. 162-164, 1924.

Ovis ammon kozlovi A. B. Howell, Proc. U. S. Nat. Mus., vol. 75, art. 1, p. 79, 1929.

Ovis ammon darvini G. M. Allen, Amer. Mus. Novitates, no. 410, p. 1, 1930.

W. (lapsus for Ovis) a. intermedia Gromova, Neue Forsch. in Tierzucht u. Abstammungslehre, Festschr. z. 60 Geburtstag von Dr. J. Ulrich Duerst, p. 82, 1936. Noin Bogdo, central Gobi.

Type specimen.—The type of *Ovis darvini* is doubtless to be considered as one of the specimens brought back by Przewalski from the Khurkhu Mountains, central Gobi, about 1880, and now in the Zoological Museum of the Academy of Sciences at Leningrad. The type of *O. kozlovi* from the south slope of the Yabarai is No. 7794 in the same collection.

Description.—Individual sheep vary more or less in color so that too much reliance cannot be placed on small differences in tint in the discrimination of races from few specimens. An adult male, No. 57301, from Artsa Bogdo, Mongolia, August 23, 1922, is nearly a topotype of *O. a. darvini*, and may be described as follows: muzzle, sides of head and upper throat grayish brown slightly grizzled with white; rest of the upper neck and the back yellowish brown, with a somewhat variegated or "watered" appearance, varying from about "sayal brown" to "snuff brown"; flanks from axilla to groin and front of thigh a more uniform and darker brown, nearly bistre; buttocks

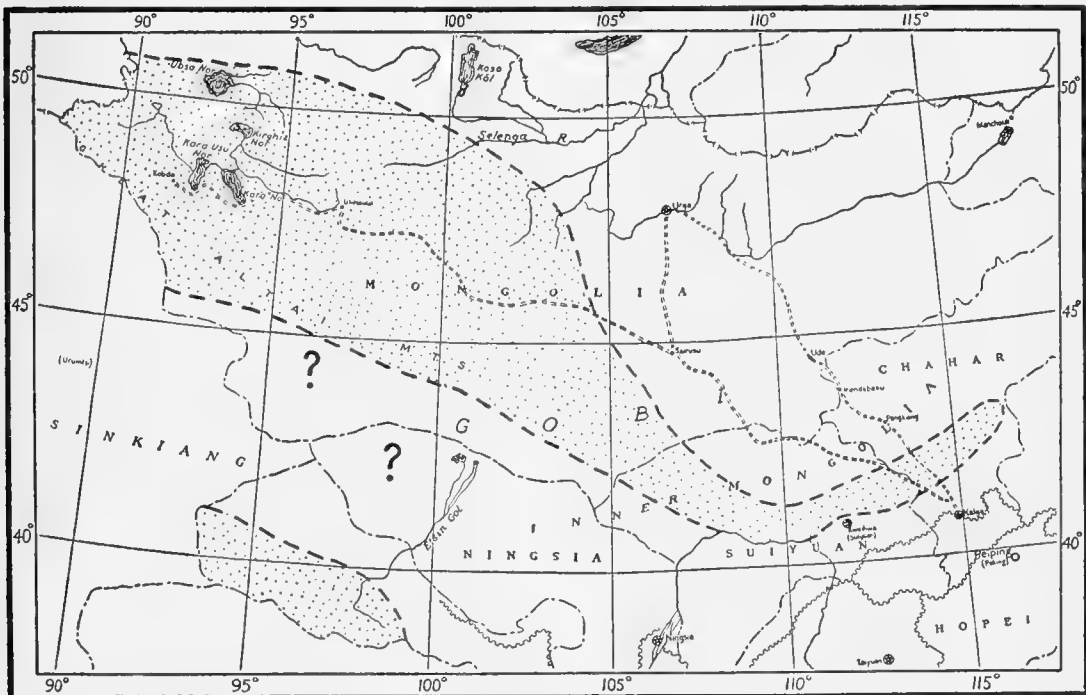


FIG. 72. Distribution Map.

Ovis ammon darvini

grading into "light ochraceous buff" without a well-defined rump-patch; tail with a brown median line, buff sides and a number of white terminal hairs. Legs with a stripe down the front of mixed brown and white, the rest pale ochraceous buff. Belly whitish in the inguinal region, this pale area extending forward to the chest, where it becomes tinged with buffy. Longest hairs of the upper neck about 40 mm., on the body about 20 mm. long. Another skin from the same place has much more white, the area from in front of the eyes to the muzzle whitish, and all the lower throat so mixed with white as to give the predominating tint; lower fore leg below the knee white and the hind leg below the hock white slightly mixed with brown.

A male taken at Kweihwacheng in late October represents the winter pelage. A median area covering the rostrum from in front of the eyes to the nostrils and a small spot marking the suborbital gland are obviously more white than the surrounding areas, though very slightly mixed with brown; upper lip and middle of chin whitish. Sides of face and of upper neck, as well as the middle of the lower throat, mixed rusty brown and gray, giving a decidedly pale effect to the upper neck as far as the shoulders. Body elsewhere brown except the whitish inguinal region, narrow pygal area and the feet which are mixed brown and black above the knee, more whitish below, with a narrow line of brown grizzled. Hind legs similar. The white of the buttocks is not sharply marked off, but grades into the dark of the flanks, and is not pure white but shows a slight buffy wash. The tail is dull brown above, mixed with whitish, and white on the sides and below.

Measurements.—The following external measurements are of four males shot by Dr. R. C. Andrews at Kweihwacheng, northern Shansi:

No.	Total length	Tail	Hind foot	Ear
45491	1706	110	465	108
45492	1550	110	471	110
45493	—	110	405	110
45494	1446	127	432	110

CRANIAL MEASUREMENTS OF *OVIS AMMON DARVINI*

No.	Greatest length	Basal length	Palatal length	Zygomatic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Sex	Locality
45495	335	305	170	170	114	94	92	104	♂	Shansi
57300	290	270	147	149	102	82	88	84	♂	Mongolia

Sjölander (1922, p. 148) gives measurements of a dozen full-grown rams from the Kweihwacheng district: height at shoulder, $41\frac{1}{4}$ to $45\frac{1}{2}$ inches (1,047-1,155 mm.); nose to tip of tail, 60 - $65\frac{1}{2}$ inches (1,530-1,670 mm.); longest horns, $47\frac{1}{2}$ inches, tips broken. The horns do not attain the length of those of *O. ammon ammon*, but exceed them in girth, while the tips are less everted.

"Rowland Ward's Records of Big Game" (9th edition, 1928) gives 50½ inches (about 1,286 mm.) as the record length of horn measured on the outside curve for the argali of southern Mongolia, together with a series of other horn lengths, ranging from 42-45 inches, of sheep from the Ta Ch'ing Mountains of northern Hopei. The largest of the three heads from Kweihwacheng, northern Shansi, is 41 inches.

Nomenclature.—Various technical names have been applied to this eastern argali. Severtzov in 1873 called it *Ovis argali mongolica*, while Peters three years later, apparently unaware of this author's work, renamed it *Ovis jubata*, basing his description and figures on specimens from the eastern part of Mongolia north of Peiping. Both of these names, however, *mongolica* and *jubata*, had been previously used for races of the domestic sheep, so that Hollister in 1919 replaced Peters's name by *Ovis comosa*. Meanwhile in 1913 Nasonov had described as *Ovis kozlovi* a sheep of the southern Gobi from the Yabarai Mountains, believing it to be a dwarf desert race isolated on this range, and cut off by desert sands from its neighbors to the northward. Later, in his monograph of 1923, Nasonov made this a race of *O. ammon*. He likewise regarded as distinct races *O. darvini*, the sheep of the Khurkhu Mountains, central Gobi, named by Przewalski in 1884, and *O. przewalskii*, the sheep of the Salūghem and Kobdo River basin in western Mongolia. The distinctions are based in part on slight variations in the curve of the horns, which Nasonov has analyzed and reduced to formulæ. Probably the differences are too much subject to variation to prove very trustworthy as a means of racial distinction, for Sushkin in reviewing this fine monograph (in Russian) regards at least the last as doubtless a synonym of *O. ammon*. Probably the conservative course is to use Przewalski's name, *O. darvini*, for the sheep of northern China and Mongolia, leaving for further study the matter of finer distinctions over this wide area. A skin from the Little Altai near Turkuta Pass is darker than summer skins from the Gobi, as might be expected, and probably represents true *O. ammon*, but there is a puzzling amount of individual difference in the relative proportion of light and dark color, affected also no doubt by wear and possibly by discoloration. Nasonov, who relies much on the degree of curvature of the different parts of the horns in the distinction of subspecies, states that the formula is the same in sheep representing typical *Ovis ammon darvini* and those from farther east which Peters called *O. jubata*.

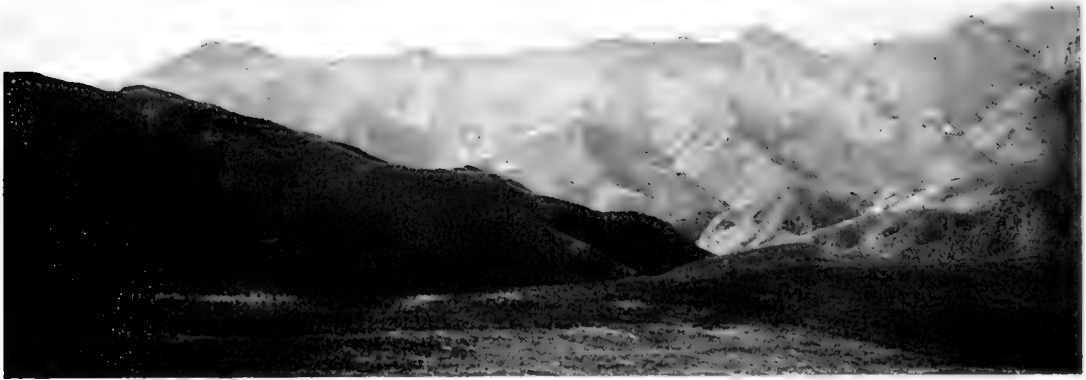
Occurrence and Habits.—This sheep has large heavy horns, curving up and out, then forward, with a slight "pinching in," so that the inner sides of the forward curves are slightly convergent instead of parallel or divergent, with an outward flare of the tips in the terminal third, as viewed from the front.

There is, however, a slight individual variation in this respect, for in one skull examined the inner faces of the middle third are practically parallel.

No doubt the local range of Mountain Sheep has been somewhat restricted during the last century in the eastern part of its range, through human interference and other causes. Radde, writing about 1860, says that they are not to be found in the Kentai, Khingan and Bureja Mountains of southeastern Siberia along the northern border of Mongolia, but reach the upper course of the Selenga River and the mountains of extreme eastern Mongolia. In Pallas's time they were apparently found in other localities between. About 1831 they were exterminated in the Dalai Nor region. Twenty years after Radde, Przewalski found them in his first journey into the mountains of Suma Khada, northern Shansi (northwest of Peiping), and probably the specimen described by Peters as *O. jubata* came from near this same region. Przewalski found them in small bands of from five to fifteen, keeping pretty much to the upper slopes of the mountains, coming down at intervals to the flatter country about the base to drink at springs, and sometimes even mingling with the cows and sheep of the Mongols, pastured there. He supposed they moved but little from chosen localities, but it seems more likely that from time to time they seek new grounds as they are known to do elsewhere. In the waterless country of the Khurkhu Mountains, Przewalski believed the sheep obtained their moisture from succulent vegetation, such as the plant called "budargana" and occasional wild onions. He found argali in the mountains bordering the north bend of the river Khuanke (Chuanche?) and in the Shug Range, while Kozlov also reported them from the neighboring Burchan-Budda Mountains. In his first journey Przewalski had reports of sheep in the mountains of Kansu, perhaps in the western parts, and he later noted their presence in the northern Ala Shan, where Kozlov also found them, as well as in the Humboldt Range of Nan Shan. In the extreme northwest of Mongolia, sheep are present in small numbers, as reported by Demidoff (1900), along the River Suok and the upper Kobdo. Apparently the ranges of hills and mountains stretching more or less brokenly across the central Gobi from northwest to southeast have been a factor in enabling sheep to find their way across to northern Shansi. Beyond the mountain plateaus of Shansi and the mountains north of Peiping they seem not to have penetrated within historic times, although Sowerby (1924h) mentions a report of one in southern Shansi. It is interesting, however, that Matsumoto (1926) has found fossil remains of a similar or identical sheep which he names *Ovis ammon shantungensis*, from near Chinchow in Shantung, indicating a wider range for the species at no very remote date.

Sjölander (1922) has given a summary of the distribution of this sheep in recent years, partly from literature and partly from his own experience. He states that it is no longer to be found in the mountains north of Peiping but

PLATE XIX



Sheep country near Kweihwacheng, northern Shansi



Darwin's Sheep or Argali (*Ovis ammon darvini*), killed in northern Shansi

was discovered in the frontier range Tatsing Shan between Suiyuan and Mongolia about the beginning of this century. At the present time they are most plentiful in a small district just north of Kweihwacheng, northern Shansi. The range in question extends in a general east-west direction from the mountains Shara Khada, Suma Khada, Charaktshin Ola and Ongün Ola on the east to perhaps a couple of hundred miles west of Kweihwacheng. "In the narrow zone between the Mongolian Plateau and the Suiyuan plain we find all that remains of the once more numerous and more widely distributed Argali sheep . . . they are no doubt doomed to extinction within the not very distant future" as cultivation penetrates deeper and deeper into valley bottoms and grassy hillsides. "One finds them in small herds here and there on the innumerable ridges or on the slopes of the deep valleys. The flocks generally consist of a small harem of females and youngsters with one or more, often several rams of different ages in company. Very old rams are sometimes met with all alone far up in desolate valleys living like hermits by themselves. But it is not unusual to find two or three rams in company, of which the biggest seems to be the leader. In Ta-tsing Shan they are not found . . . in large herds. The largest flock I saw on Ongün-Ola, consisted of twenty-two animals; of this at least half were rams of which several carried imposing horns. . . . Where they were seldom disturbed . . . small herds or single animals could be seen day after day on the same slopes, grazing or resting. . . .

"Like other wild sheep they graze morning and night, sometimes also in the middle of the day, but in the forenoon go to rest one after another often on the very grazing-ground. . . . On warm calm days they choose a resting place high up on the slopes; when the wind is strong and cold, further down or even on the bottom of the valley.

"During my visit here in the autumn of 1920 a long stormy period occurred during which it was useless to seek the sheep on the windy slopes, they were all on the lee side of the hills or down in the valley." In the autumn, Sjölander continues, when the snow is deep on the highlands, the sheep retire to the hills bordering the plains. He mentions their curiosity, and recounts being able to toll a flock to within one hundred yards by imitating the angry bleat of a ram, near the end of the rutting season. Przewalski mentions, also, that the Mongols sometimes attract them by hanging a piece of cloth from a pole.

Various excellent accounts of hunting sheep in Mongolia and northern China have been published: Carruthers (1914) and Demidoff (1900) in western Mongolia; Sowerby (1918, chap. 6), Caldwell (1924) and Sjölander (1922) in the country north of Kweihwacheng; while a general account of the species was published by Pousargues (1896a). Dr. Roy C. Andrews found them "fairly abundant at Artsa Bogdo and were said to be found on Baga Bogdo though I did not hunt them on that mountain. Artsa Bogdo is ideal sheep

country, high rolling grassy slopes and shallow and deep ravines. The grass is long and rich; in the bottoms of the higher ravines there is a growth of the trailing cedar which the Mongols call 'artsa' and it is among the 'artsa' that the sheep like to sleep during the middle of the day. When I hunted them (August 15-28) the females and young were alone and the rams by themselves in pairs and herds of eight or ten. They feed from daylight till 9 or 10 o'clock and again about two hours before sunset. Berkey and Morris saw many sheep at Gurban Saikan and report ideal conditions for them there."

In the first volume of this series (p. 156) Dr. Andrews adduces instances from his own observations and those of Dr. Walter Granger conclusively proving that sheep will often cross stretches of open desert from one range of isolated hills or mountains to another, and similar habits have been recorded for Mountain Sheep in southwestern United States. The possibility that these animals may develop local subspecies through isolation on desert ranges is therefore small, since occasional crossing of the intervening area would from time to time take place in both directions, to and from some larger range. Dr. Andrews writes that, according to the Mongols, such crossings usually take place during winter.

Specimens examined.—The following twenty-eight:

Mongolia:

Artsa Bogdo, 7.

China:

Shansi: near Kweihwacheng, 13 (3, M.C.Z.).

No exact locality, 8.

Genus *Pseudois* Hodgson

Pseudois Hodgson, Journ. Asiatic Soc. Bengal, vol. 15, p. 343, 1846. Lydekker, Cat. Ungulate Mamm. Brit Mus., vol. 1, p. 126, 1913.

Ovis Hodgson, Asiatic Researches, vol. 18, pt. 2, p. 135, 1833 (in part); and later authors.

Pseudovis Gill, Arrangement Fam. Mamm., p. 79, 1872.

This special genus for the Bharal or Blue Sheep differs from typical *Ovis* in the peculiar shape of the horns which (in the male) recalls that of the Caucasian Tur in being directed upward, then outward and finally posteriorly with a slight ridge or keel on their inner border, instead of forming a lateral spiral. Other external characters are the slightly longer tail, the absence of suborbital glands, although their usual site is marked by a patch of naked skin, and the usual absence of foot glands. The mammae are two, inguinal, as in *Ovis*. The orbits of the skull stand out laterally, the upper ends of the premaxillaries are in contact with the nasals, and the lachrymal bone is almost on the upper surface of the face. In correlation with the absence of a suborbital gland, the lachrymal, like that of the goats, has no pit or excavation for such a gland. The basicranial axis makes a considerable angle with the facial

axis of the skull. The tooth formula is as in *Ovis* and *Capra* and there is similarly an absence of an accessory small column of enamel in the molars at the entrance to the valley separating the anterior and posterior crests of the teeth. According to Lydekker (1913), "the genus is intimately connected with the goats by means of *Capra cylindricornis*."

The range includes the Himalaya Mountains from Kashmir eastward to the western highlands of China, with an eastward extension into Kansu and northern Shensi. The Chinese animal is believed to represent a distinct subspecies.

For an important paper on the external characters and relationships, see Pocock, 1918.

510. *Pseudois nayaur szechuanensis* Rothschild

CHINESE BLUE SHEEP

Pseudois nahoor szechuanensis Rothschild, Ann. Mag. Nat. Hist., ser. 9, vol. 10, p. 231, 1922.

Ovis nahoor Milne-Edwards, Recherches pour servir à l'Hist. Nat. des Mammifères, p. 357, pls. 68, 69, 1868-74 (in part).

Pseudois nahoor Pousargues, Mém. Soc. Zool. de France, vol. 11, p. 156, 1896 (in part). Lydekker, Cat. Ungulate Mamm. Brit. Mus., vol. 1, p. 126, 1913 (in part).

Pseudois nayaur casia A. B. Howell, Proc. Biol. Soc. Washington, vol. 41, p. 118, 1928; Proc. U. S. Nat. Mus., vol. 75, art. 1, p. 79, 1929. Archuen, Kansu.

Pseudois nayaur szechuanensis G. M. Allen, Amer. Mus. Novitates, no. 410, p. 2, 1930.

Type specimens.—This race was based on two specimens in the British Museum, both of which are thus cotypes, namely, a skull from "Shensi" and a mounted skin with horns from Szechwan, no numbers or more exact information given. The skull was collected by Dr. J. A. C. Smith.

Description.—An adult male in winter pelage (October 8) has the muzzle and face a mixed dull whitish and black, due to the hairs having whitish bases and a short black tip. The rest of the upper surface of the body from the occiput to the neck and back as far as the base of the tail is a general buffy brown, the individual hairs having a drab basal part which more or less shows through, then a broad subterminal band of ochraceous buff, and a fine black tip, which may not be present in all the hairs. Sides of the face and lips whitish, the former somewhat mixed with black-tipped hairs. Front of the neck and throat blackish with a tinge of brown, becoming deep black as it continues to the fore leg and passes down as a stripe on the front aspect, to the hoof. Behind the axilla is a short break in the black area, which then continues as a narrow black stripe along the flanks to the groin and thence down the front of the hind leg to the hoof. Anteriorly the stripes of opposite sides meet in the middle of the chest and are separated from the black of the fore throat by a narrow area of white. Middle of the belly and inner sides of the legs continuously white, which extends up along the posterior side of the buttocks to

the basal outer half of the tail. The latter is short, black above and all around in the terminal half, its color merging with the mixed buffy brown of the back anteriorly, thus separating the white of the inner side of the hind legs.

In the females the throat is nearly white, slightly mixed with black, and the lateral stripes are less wide and conspicuous. In immature animals the ochraceous-buff tips of the dorsal hairs are short and expose more or less of the drabby bases of the hairs with slight wear, giving a grayish effect.

The characters distinguishing this from the typical race of the Tibetan frontier of Nepal are said to be: face-mask much browner, not blackish gray; neck, sides and back tinged with mauve, not brownish; lateral black stripes less sharply marked and ceasing abruptly three or four inches behind the shoulder instead of almost joining the dark chest patch; other black markings less sharp or reduced. It seems probable that there is considerable individual variation in the details of color and markings, for in the male described above, from near Tatsienlu, Szechwan, the lateral black stripes actually, though narrowly, join the dark chest patch instead of ending abruptly. The male figured by Milne-Edwards shows no lateral stripe and the belly appears to be buff instead of white.

The skull and teeth are well figured by the same author. The premaxillaries are rather delicate and tapering, the face nearly flat between the orbits and the ventral edge of the lachrymals forming a raised ledge, bounding an excavation just beneath for muscle attachment. The nasal bones are wide at their proximal ends and taper forward to a point, instead of being more or less the same width throughout.

The horns of the female are short and nearly straight, about 5 inches long with a keel on their inner edge.

Measurements:—Milne-Edwards gives the following dimensions of an adult but not old ram sent by Père David from Muping (first column), to which are added those given by Wallace (1913) for a male from Min Shan (second column):

Total length from nose to base of tail on the curves of the body in	mm.	mm.
a median line.	1310	1398
Length of trunk in a straight line from front of breast to anus . . .	700	—
Length of tail.	130	205
Length of ear.	90	—
Height at shoulder.	700	895
Length of body (head and body) in a straight line.	—	1223

Wallace states that the approximate weight of the male specimen he shot was 160 pounds. Weigold estimated the weight of an adult female he shot at about 35 kilograms (75 pounds). The largest horn measurements for

Chinese specimens listed in "Rowland Ward's Records of Big Game" (9th edition, 1928) are about $26\frac{1}{2}$ and $24\frac{1}{4}$ inches, while, for the typical race, horns measuring $33\frac{1}{4}$ inches on the front curve are the maximum. Chinese heads average much greater in their tip to tip measurement, even though the horns are shorter than in Himalayan Blue Sheep.

CRANIAL MEASUREMENTS OF *PSEUDOIS NAYAU* *SZECHUANENSIS*

No.	Greatest length	Basal length	Palatal length	Zygomatomatic width	Mastoid width	Width outside molars	Upper cheek teeth	Lower cheek teeth	Sex	Locality
29958 MCZ	250	213	133	131	93	65.0	67.5	73	Ad. ♂	Szechwan
29960 MCZ	215	193	122	109	78	58.5	66.0	—	Ad. ♀	Szechwan
63050	—	—	—	120	87	60.0	69.0	72	Ad. ♂	Kansu
63051	220	196	120	114	77	58.0	67.0	69	Ad. ♀	Kansu

Nomenclature.—The separation of the Bharal as a distinct genus from *Ovis* is no doubt warranted, as Pocock (1918) insists, not only on account of the peculiar shape of the horns, but especially on account of the suppression of the suborbital and pedal glands and the indication of subcaudal glands, characters in which it approaches the goats and stands apart from the sheep. Though the specific name is persistently spelled *nahoor*, the usual form of the native name, Hodgson's original spelling was *nayaur*, which is therefore to be retained. In describing the animal of western China as a separate race, Rothschild uses distinctions which are subject probably to considerable individual variation, and may be also due in part to age, sex, and wear or fading of the pelage. Nevertheless, it is very likely a valid form and was so regarded by A. B. Howell, who, unaware of its having already been named by Rothschild, described it in 1928 as subspecies *cæsia*, which thus becomes a synonym of *P. n. szechuanensis*.

Occurrence and Habits.—The range of the species extends from "Hunza and Nagar, through the Shigar district of Baltistan, Garhwal, and Tibet, to Sze-chuan, Shen-si, and Kan-su" as outlined by Lydekker (1913), who was perhaps the first to suggest that those of the two last localities might prove a distinct race. Within Chinese territory it is found at high levels on the eastern extension of the Tibetan plateau from about Tatsienlu northward in extreme western Szechwan, but probably not in Muping, the locality in this province from which Milne-Edwards records the specimen sent by David. Pousargues has given a general summary of the habits and distribution in his paper of 1898b, tracing it from Szechwan northward to the mountains along the southern edge of the Gobi from Altyn Tagh and Nan Shan in extreme western Kansu, and thence to Alashan and Khara Naryn Ola to the north of the great bend of the Hwang Ho, and mentions specimens in the Paris Museum from Tatsienlu and "Tszekou." Wallace (1913) has given an entertaining account of hunting

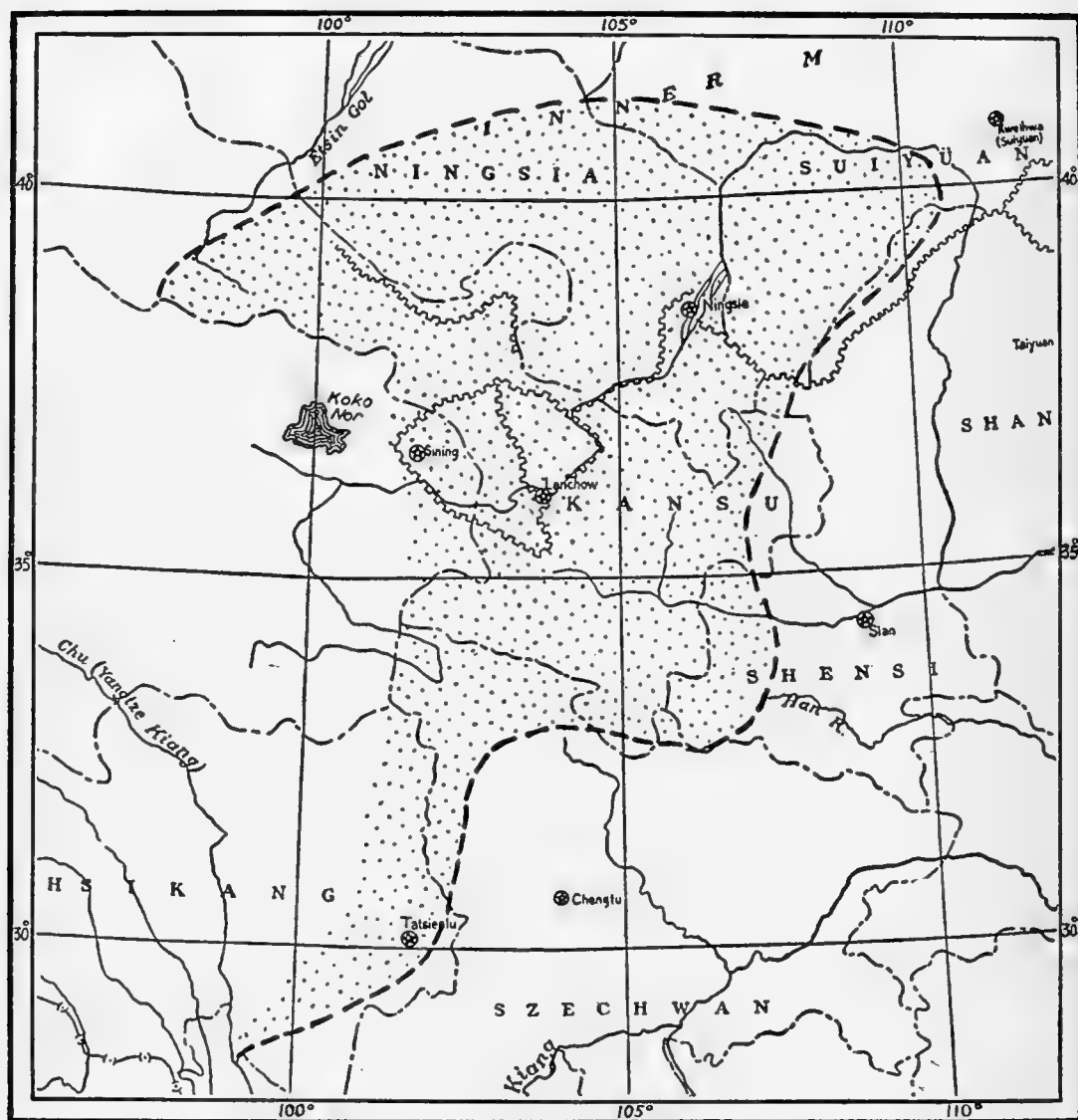


FIG. 73. Distribution Map.
Pseudois nayaaur szechuanensis

the Blue Sheep in the Min Shan of southern Kansu, where apparently it is present in some numbers in small bands, usually consisting of a number of ewes and their young, headed by an old ram. In summer they are to be found on the grassy and rock-strewn slopes of the mountains above timber line and are, as usual, wary and watchful, making it difficult to stalk within range. He writes that they are rather clumsy-looking about the quarters and have a curiously lanky appearance when moving over the bare grassy slopes on which they feed. Their general gray-brown color may in certain lights have

a distinctly blue aspect, and so closely do they harmonize in tint with their alpine surroundings of gray rock and brownish grass that they are at times extremely difficult to make out if they are still. Apparently they remain on the heights above timber during the winter as well as in summer, where dry grass is obtainable on slopes swept bare of snow even at this season. Fergusson (1911) in his book, "Adventure, Sport and Travel on the Tibetan Steppes," has an interesting chapter on hunting the "panyang" in the high mountains of the Wassu country, upper Min River, northern Szechwan. Here in mid-March the sheep were common between the tree limit and the snow line, "that is, from 12,000 to 17,000 feet. The old males leave the females in June or July and live by themselves." He says that they have the habit of grazing near rocky ground in which they take shelter if startled. When feeding, they always post a sentry who stands amid some jagged rocks whence he may obtain a good view, and "where it is impossible to distinguish him from the surroundings. He does not move his head, and one is attracted to him, if at all, only by the sudden bound he takes when leaving his watch tower, and which is the signal to his companions that it is time to be off."

According to Jacobi (1922), winter skins of males are overwashed with slaty gray; the ewes, however, are browner. He adds a few notes from the collector, Weigold, who secured a male at Chienlangshan and a female at Gonchen in Derze, on the extreme western border of Szechwan. Here they are found in winter at altitudes of from 2,400 meters up, and in summer from the zone of dwarf trees to the steepest cliffs at the mountain summits. Their bands number up to about a dozen individuals of all ages, not always, however, with a leading ram. Two young are frequent at a birth, and these are not weaned until quite three-quarters grown. Their color is darker than in adults. They are not especially active animals, but will often stand in one place all day, gazing as if looking into space, but no doubt keeping sharp watch for danger from below. The natives occasionally catch them in snares. Until about two decades ago, Blue Sheep were not known to be found eastward of the Min Shan in southern Kansu, but Sowerby (1923a and 1923d) records how Mr. J. H. Denver-Jones, while traveling in this province, discovered that they were present in considerable numbers "in a little known area lying to the south-west of Ning Hsia" and secured several fine heads in the vicinity of Lanchow, as well as a young lamb which he brought alive to Shanghai, and eventually disposed of to an animal dealer. In the second note (1923d), Sowerby publishes photographs of a mounted head shot by Captain V. James of the U. S. Army in northwest Shansi or just over the border in Mongolia. The U. S. National Museum has specimens from Archuen and Ningsia, as well as three from what is perhaps the same place as that whence Captain James's specimen came, "157 miles west-northwest of Paotowchen, Inner

Mongolia" (A. B. Howell, 1929). There is a specimen in the British Museum from Shensi collected by Dr. J. A. C. Smith, which marks no doubt the eastward limit of the range, in the southwestern corner of that province.

On his recent expedition of 1934-36 to western Szechwan and eastern Tibet, Mr. Brooke Dolan and his assistant Schäfer obtained specimens of what at first seemed to be a dwarfed Blue Sheep. These lived in the deep gorge of the upper Yangtze, near Leh and Drupalong, and appeared smaller and with less heavy horns than those of the upper grassy altitudes of the same region. A zone of thick scrubby forest three or four miles across and covering about fifteen hundred feet of altitude intervenes between the two areas, so that the sheep of these gorges seemed to be cut off from those of the heights. Both Dolan and Schäfer, who collected a series of the sheep, were inclined to believe that they represented an undescribed local race, as mentioned casually by Sowerby in his paper on the expedition (1936a). A careful comparison of the specimens shows, however, that most of them are immature; nevertheless, skulls of comparable age do run slightly smaller in the case of the valley animals, as in total lengths, and diameters of horn cores, but the gaps are bridged by individual variations and it does not seem possible to point out clear distinctions. Possibly the valley individuals, living on the sides of the rocky gorges where food is less abundant, may be somewhat depauperate or slower in attaining full size. It does not seem likely that the intervening belt of forest would prove an insuperable barrier sufficient to delimit a subspecies.

Specimens examined:—The following fifteen:

Kansu: thirty li south of Archuen, 3.

Szechwan: Drupalong, south of Batang, 6 (A.N.S.P.); Leh, 3 (A.N.S.P.); Tatsienlu, 3 (M.C.Z.).

Genus *Capra* Linnæus

GOATS

Capra Linnæus, Syst. Nat., ed. 10, vol. 1, p. 68, 1758.

Eucapra Camerano, Atti Reale Accad. Sci. Torino, vol. 51, p. 570, 1 pl., 1916.

For other synonyms see Lydekker, Cat. Ungulate Mamm. Brit. Mus., vol. 1, p. 129, 1913.

The goats are structurally closely related to sheep, differing chiefly in the general shape of the horns, which are either in the form of a long sweeping backward curve or of a corkscrew-like narrow spiral. The tail is longer than in the mountain sheep, there is no suborbital gland, and foot glands are lacking in the hind feet. Mammæ two, inguinal. The males have the horns better developed than the females and are provided with a beard on the lower jaw. The skull shows no pit in front of the orbit. The teeth are much as in *Ovis*, but lack the ridge-like development at the posterior corner and middle of the

premolars. In general the goats are rather more stocky in build than sheep, with shorter legs, and short deep hoofs more adapted for rock-living. They delight in rough, rocky and mountainous country, perching sentinel-like on boulders whence they may keep watch of the surrounding heights.

The only representative of the genus occurring naturally within the area here treated is an ibex which is found on the northern border of Mongolia and in the central part of the Gobi. In this group the scimitar-like horns have a number of large transverse bosses on the front. Camerano has proposed a special genus, *Eucapra*, for them, but this seems unnecessary. There is a good deal of uncertainty as to the number of valid races of Asiatic Ibex, and also as to the closeness of relationship between these and the European members of the genus. At the present time there is a long gap between the latter and the most western of the Asiatic forms, so that the best course seems to be to regard as a distinct species the one named *C. sibirica* of the Lake Baikal area, with subspecies.

511. *Capra sibirica sibirica* F. A. A. Meyer

SIBERIAN IBEX

Capra sibirica F. A. A. Meyer, Zool. Annalen, for 1793, vol. 1, p. 397, 1794. Lydekker, Cat. Ungulate Mamm. Brit. Mus., vol. 1, p. 142, 1913.

Capra pallasii Schinz, Neue Denkschr. Allgemein. Schweiz. Ges. f. die Ges. Naturwiss., Neuchâtel, vol. 2, p. 9, 1838 (not *Aegoceros pallasii* Rouillier).

Capra sibirica var. *hagenbecki* Noack, Zool. Anzeiger, vol. 26, p. 381, 1903. Lydekker, Cat. Ungulate Mamm. Brit. Mus., vol. 1, p. 145, 1913. Kobdo, Mongolia.

Capra sibirica sibirica Lydekker, Cat. Ungulate Mamm. Brit. Mus., vol. 1, p. 143, 1913. G. M. Allen, Amer. Mus. Novitates, no. 410, p. 3, 1930.

Type specimen.—Meyer's name is based on the description of the Ibex of the Siberian alps by Pallas, whose specimens, if they were preserved, are not known to be still in existence. The locality, as given by Lydekker, is the northern slope of the Syansk Mountains in the neighborhood of Munku Sardyx, west of Lake Baikal.

Description.—Adult males in summer pelage are yellowish brown above, fading on the sides to pale ochraceous and on the chest to buff. A narrow black line extends from the occiput nearly to the base of the tail, the tip of which is blackish brown. An area in front of the eyes extending transversely across the bridge of the muzzle is more or less dark brown like the beard. The belly is clear white. The entire front of the neck and center of the chest may be more or less ticked with blackish brown. There is a dark stripe of blackish brown down the entire front side of the legs from the upper arm and the groin to the hoofs. There is considerable variation in the detail of the coloring in skins from the same locality. Thus No. 60364, an adult male, is black-throated, the black heavily continuous from the side of the throat down the

front of the fore leg; the chest is somewhat mixed with blackish as are the sides of the belly, which is white, bounded as usual by reversed hairs. The black mid-dorsal stripe ends abruptly about four inches from the base of the tail.

In females the black dorsal stripe may be traced as a narrow line to the middle of the back, or it may be absent altogether. The dark stripe of the fore leg may be interrupted at the knee, and the beard if present is smaller and thinner than in the male. Chest usually buffy, the belly white.

In winter coat the animal is much paler, with usually a pale saddle patch and a generally yellowish-white tint elsewhere. Lydekker describes the winter coat as long, tending to form a crest medially, and varying in color from dirty yellowish white to purer white in the middle of the back; under parts browner, due to dark hair-tips; forehead, ring around the eye, occiput, ears and sides of the neck darker. A narrow dark dorsal line and faint shoulder stripe. Old bucks may become nearly white. Lorenz von Liburnau (1907) has published an excellent colored plate of the animal in winter pelage.

The horns are large and heavy for so small an animal, curving scimitar-like over the back, and slightly diverging. There is a series of prominent knobs along the front of the horns. In adult skulls the nasals tend to lose their articulation with the upper end of the premaxillaries, and there is a narrow vacuity between them and the maxillaries and lachrymals, so that they are supported by their frontal connections alone.

Measurements.—No external measurements are available.

CRANIAL MEASUREMENTS OF *CAPRA SIBIRICA*

No.	Greatest length	Basal length	Palatal length	Zygomatic width	Mastoid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Sex	Locality
60369	265	243	140	137	104	74	69	—	Ad. ♂	Mongolia
57307	230	210	128	130	92	68	74	76	Ad. ♀	Mongolia

Nomenclature.—In his review of 1913 Lydekker lists no fewer than twelve supposed races of the Asiatic Ibex in addition to the typical form. Three of these are described from the Altai region and two from the Tien Shan, but appear to be based on slight variations of color or conformation of horns, without comparison with enough specimens to determine in how far the differences are seasonal or individual or due to age. The series brought back by the American Museum Asiatic Expeditions from the Gobi is probably near enough to the type locality in southern Siberia to be considered without doubt true *C. s. sibirica*. If this is the case there can be little doubt that *C. sibirica hagenbecki* Noack, described from Kobdo in western Mongolia, is the same, and I have provisionally placed it in the synonymy of the typical race. Noack made comparison only with Altai specimens from still farther west, instead of with topotypical material from the Syansk Mountains.

Occurrence and Habits.—The range of the ibex in the Gobi region and in western Mongolia somewhat parallels that of the Mountain Sheep, although not extending quite so far east and south. Pousargues (1898b, p. 168) has already pointed this out, and traces the southern limits of the range in this region as extending southeast from the Syansk Mountains to the Khurkhu Mountains in the Gobi, as well as to the In Shan. According to the Mongols, it was said to occur on the Ygrai Ola in the angle northwest of the Alashan

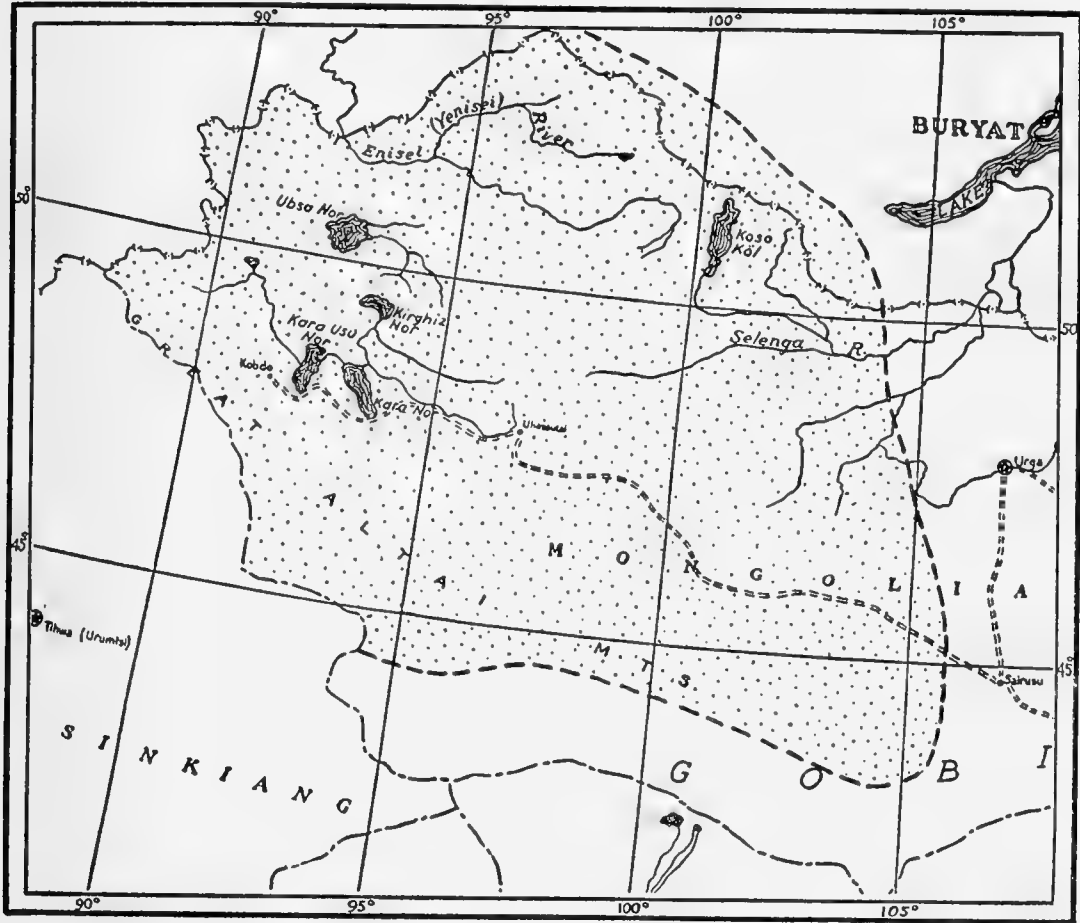


FIG. 74. Distribution Map.
Capra sibirica sibirica

Desert (Przewalski, 1884). Westward it is found in suitable localities across northern Mongolia to the Altai. Related races extend the distribution from thence southward to the Himalayas, from Lhasa to Kumaon. The series obtained by Dr. R. C. Andrews was all secured in the Artsa Bogdo region, central Gobi. He writes of his experience with them as follows: "The animals were very wary. I often watched a herd, which would be led always by an

old female. She would come carefully up to the summit of a ridge and survey the country for ten or fifteen minutes. Then at an obvious signal from her that all was well, the remainder of the herd would slowly come up. Their senses of smell, sight and hearing are very acute, but I believe smell is most keen.

"I spent four days hunting in the mountains in the west part of Artsa Bogdo where the range is highest. I had a good hunter who told me that I would find bucks there and sure enough, we found bucks in herds and very few females. The largest herd was nineteen, practically all bucks, which (in late August) seemed to have concentrated here in the higher mountains, leaving the lower ridges to the females and young. Of the nineteen, eleven had horns of not less than 35 inches long, and the others were smaller, with about 22-inch horns. I shot one which had 37-inch horns but doubt if any reached a length of 45 inches, and certainly none attained the 50-inch horns reported by Carruthers from the Tian Shan.

"The bucks are exceedingly difficult to kill, my 6-mm. Mannlicher, which proved sufficient for the largest sheep, not being heavy enough for ibex."

Specimens examined:—Eighteen, adult and young, from Artsa Bogdo, Mongolia; one from Kobdo, Mongolia (Tring Museum).

CHAPTER XV
ORDER PERISSODACTYLA
ODD-TOED UNGULATES

At the present day this is a waning group, represented in the Old World by a few species of horses, rhinoceroses and tapir, while in the New World only the last of these still survive in a wild state. Most of them are now of tropical distribution, except for some of the horse-like species that have extended into the north temperate zone. They are characterized as a group by the method of toe reduction whereby the weight of the body is borne on the central digits, with the main axis of support passing through the third toe. In the tapirs the fore feet still retain a fourth toe (digit 5) but the hind feet are three-toed, and this condition obtains in both fore and hind feet in the rhinoceroses. The horse group has carried this reduction to the extreme, leaving only the third digit of each foot functional, in correlation with their more cursorial habits. The third trochanter of the femur forms a prominent crest for muscle attachment instead of being very slightly developed. The teeth show considerable specialization in accordance with the nature of the food, but at least some of the incisors and both upper and lower canines are retained, with a diastema between the latter and the first premolars. The premolars tend to become transformed like the molars into grinding teeth, with prominent cross-crests in the tapirs and rhinoceroses, while in the horses, which are grazers rather than browsers, the teeth develop long crowns with four fundamental columns corresponding to the four principal cones of a primitive molar, with the addition of infoldings which by wear give a roughened surface of alternating harder and softer material. Although rhinoceroses were once widespread over Asia and have left abundant fossil remains in deposits of no great geological age in China, there seems to be no evidence that they have occurred even in southern China within historic times, unless one accepts the brief statement of Du Halde (1738), written two hundred years ago, that in Kwangsi, near the city of Wuchow, "one meets here with the Rhinoceros." Nevertheless, there is nothing improbable about the report, for rhinoceroses of three species still occur in Indo-China and western India. Moreover, Ingram (1925) mentions ancient inscriptions on bone recovered in Honan

during archæological investigations, which record the capture of elephants, horses, and rhinoceroses. It is believed that these inscriptions date from about 3,690 years ago, but whether or not the animals mentioned were hunted in Honan or much farther south or west is not clear (see also Chang, H. T., 1926).

At the present day the only members of the order known to occur naturally within the borders of the area here covered are the two species of horse and wild ass living in the deserts or plains of Mongolia, members of the family Equidæ.

Family EQUIDÆ

HORSES, ASSES, AND ZEBRAS

The family Equidæ is characterized by the reduction of the digits, at least in the living species, to a single functional one in each foot, digit 3, the lateral digits 2 and 4 being represented by the metapodials alone. The hoofs are broadly oval and very solid. The upper incisors are three on each side, with wide crowns, slightly cupped on their distal extremity. The canine is developed in males as a short compressed tooth, separated by diastemata from the incisors and from the anterior premolars. The premolars are usually three in each jaw but occasionally a very small additional one, pm1, is present at the anterior end of the series. In the lower jaw the formula is the same, with the canine, however, close against the outer incisor and only slightly exceeding it in height in males. The functional premolars and the molars have high crowns, which gradually push upward as they wear down and by their highly complex pattern of enamel foldings form an efficient grinding mill. Their structure is that of a four-cusped tooth in which each cusp is greatly prolonged upward, while the valleys between the cusps as well as the external infoldings of the enamel wall are filled in by a thick deposit of cement, giving strength to the whole structure.

Genus *Equus* Linnæus

Equus Linnæus, Syst. Nat., ed. 10, vol. 1, p. 73, 1758.

Asinus Frisch, Das Natur-System vierfüss. Thiere, in Tabellen, Tab. Gen., 1775.

In a conservative view the genus embraces all the living horse-like species, zebras, asses, and typical horses, although by some naturalists each of these groups is accorded separate generic or subgeneric rank. All agree in the general form, with long neck and head, the ears, however, of varying size; the functional digits are reduced to one on each foot; the tail is long, and provided with a terminal tuft of long hairs, or it may be more fully haired as in the domestic horse. The tooth formula is in all: $i.\frac{3}{3}$ $c.\frac{1}{1}$ $pm.\frac{3-4}{3}$ $m.\frac{3}{3}=40$ (or 42). In the males the canine is a short but functional tooth in both jaws, but in the

females it is much smaller or may be wanting. In occasional specimens there is a very small first premolar on one or both sides in the upper jaw. There is a diastema between the outer upper incisor and the canine in the upper jaw, but a very slight one in the lower, while in both jaws the canine is widely separated from the premolar-molar row. The cheek teeth are long-crowned, not forming definite roots until late in life, and gradually push out to the alveolar line as they become worn down. The first premolar is produced to a blunt point at its front end, but the other cheek teeth are squarish in outline in the upper jaw and nearly rectangular in the lower. The upper premolars are similar to the succeeding molars in enamel pattern, and consist of four columns corresponding to the four primitive cones of many other mammalian molars, and the deep valleys between them as well as their outer walls are covered with cement. With wear the cement columns internal to the two outer cones appear as somewhat triangular islands with wrinkled borders, while a long narrow reëntrant with a terminal finger-like indentation cuts off the hypocone from the protocone. The lower cheek teeth have a very different-looking pattern, formed by a single deep reëntrant of enamel from the outer side and two on the inner, the latter cutting off a rounded Y-shaped lobe anteriorly and a single recurved lobe posteriorly. The mammæ are two, inguinal. The genotype is *E. caballus* Linnæus, the horse.

Two species are found in Mongolia, the Wild Ass and Przewalski's Horse. They are easily distinguished as follows:

KEY TO MONGOLIAN SPECIES OF *Equus*

- A. Tail long-haired to the root, head short and muzzle blunter. *E. przewalskii*
 B. Tail long-haired in its terminal half, head less blunt. *E. hemionus hemionus*

512. *Equus hemionus hemionus* Pallas

MONGOLIAN WILD ASS; "CHIGETAI"

Equus hemionus Pallas, Novi Comment. Acad. Sci. Imp. Petropol., vol. 19, for 1774, p. 397, pl. 7, 1775. Lydekker, Proc. Zool. Soc. London, 1904, vol. 1, p. 432, pl. 27.

Asinus hemionus Hamilton Smith, Jardine's Naturalist's Library, Mammals, vol. 12, p. 317, pl. 20, 1841.

Equus hemionus hemionus Lydekker, Novitates Zool., vol. 11, p. 586, 1904.

Equus onager castaneus Lydekker, *ibid.*, p. 590, pl. 18; Cat. Ungulate Mamm. Brit. Mus., vol. 5, p. 13, fig. 6, 1916. Western Gobi.

Equus (Asinus) hemionus luteus Matschie, in K. Futterer, Durch Asien, vol. 3, chap. 5, Zool., Nachtrag, p. 24, 1911. Western Gobi.

Asinus hemionus hemionus Schwarz, Zool. Garten, vol. 2, p. 94, 1929.

Type specimen.—Not known to be in existence. The name was based by Pallas on the animal of Tarei Nor, Dauuria.

Description.—A rather small horse-like species, standing about 4 feet 3

inches at the shoulder. The winter pelage is grayish, that of summer much redder. Lydekker's description of the color is as follows: in winter grayish, the coat thick; in summer changing to bright rufous chestnut or reddish sandy, with a more or less marked tinge of grayish fawn on the neck. A dark ring just above the hoofs. No shoulder stripe or dark barrings on the limbs, but a narrow black stripe from withers to base of tail, not usually bordered with white. The forelock is very short, the mane short and erect, the tail black above and with its terminal half provided with a brush of long black hairs. End of muzzle, inside of ears, the throat, under parts of the body, inner side of legs, and a streak on the buttocks, either pure white or buffy white. The hoofs are large and broad, the anterior wider than the posterior.

Measurements.—Dr. Roy C. Andrews contributes the following field measurements (reduced to millimeters) of two males and an adult female, secured by him at Loh near Tsagan Nor, Mongolia.

	No. 1410	No. 1411	No. 1405
	♂	♂	♀
Tip of nose to root of tail.....	2184	—	2032
Tail vertebræ.....	483	432	470
Tail to end of hairs.....	940	991	927
Hind foot.....	584	—	—
Point of fore hoof to mid-dorsal line at shoulder.....	1346	1372	1333
Greatest girth of body.....	1588	2012	2001 (pregnant)
Length of ear from notch to tip.....	—	—	178
Circumference of neck behind ears.....	622	635	546

CRANIAL MEASUREMENTS OF *EQUUS HEMIONUS HEMIONUS*

No.	Great- est length	Basal length	Pala- tal length	Zygo- matic width	Mas- toid width	Width across molars	Upper cheek teeth	Lower cheek teeth	Width of oc- ciput	Sex	Locality
57201	504	459	233	189	97	118	160	164	54	♂	Mongolia
57206	517	463	250	193	103	119	171	165	52	♂	Mongolia
57207	526	470	244	195	97	115	170	166	58	♂	Mongolia
57208	512	459	245	203	104	122	156	155	53	♂	Mongolia
57209	550	488	261	201	107	122	165	166	55	♂	Mongolia
57212	510	455	241	195	97	116	160	160	56	♂	Mongolia
57213	529	468	255	192	98	118	165	165	55	♂	Mongolia
57214	522	462	246	209	105	115	165	163	53	♂	Mongolia
57203	505	448	232	182	95	115	166	165	48	♀	Mongolia
57204	466	445	242	188	94	114	166	—	52	♀	Mongolia
57210	530	475	248	202	105	122	175	174	56	♀	Mongolia

Although the largest of the above series of skulls is that of a male, there seems to be little significant difference in size between the two sexes.

Motohashi (1930) has published a series of craniometrical studies of this species, based on Mongolian material, with elaborate tables of measurements.

Nomenclature:—Pallas was the first to name the Asiatic Wild Ass, which, however, is less of a true ass than a wild horse, for the former is characterized by its narrow hoofs, small size and very long ears, and constitutes the subgenus *Asinus*. Pocock (1902) in his division of the Equidæ points out that the present species is a typical *Equus*, although Schwarz (1929) in a review of the races places them in the genus *Asinus*. The wide difference in color between the gray of the winter coat and the much brighter reddish sandy of summer seems to have misled Lydekker to describe the latter condition as indicating a separate race, *E. onager castaneus*, while the paler buffy or gray winter coat was described by Matschie as the race *E. (A.) hemionus luteus*. Probably, however, Schwarz (1929) is correct in regarding these as synonyms of *E. hemionus hemionus*. The type locality of both these supposed races is the western Gobi of Mongolia, the type specimen of the former (*E. o. castaneus*) being in 1904 a live animal in the collection of the Duke of Bedford, that of *E. (A.) h. luteus* a specimen (No. A.55.03.5) in the Berlin Museum.

Occurrence and Habits:—The Mongolian Wild Ass inhabits the desert portions of the country extending eastward from the Great Altai to Transbaikalia and probably the central Gobi, although the precise eastern limit is uncertain. In the middle of the last century Radde found Wild Asses in the country about Dalai Nor and Tarei Nor, lakes on the northwest boundary between Mongolia and Siberia, and secured several specimens. He describes the color in summer as a yellowish red with a gray tinge, the muzzle nearly back to the eyes, white; the winter coat he describes as more reddish than yellowish, and its individual hairs about 25-28 mm. long. It is a typical desert animal and seems to be more or less confined to the arid parts, particularly of the central Gobi. Dr. R. C. Andrews found it abundant about Tsagan Nor, living on the scanty vegetation, and apparently drinking very seldom indeed. On his journey eastward from Tsagan Nor to Kalgan, Wild Asses were not again seen till nearly opposite Artsa Bogdo when five were noted, and on the next day the geologist of the party saw another three miles farther east at the Garbun Saikhan, one of the most eastern parts of the Altai Mountains. No others were seen on the traverse to Kalgan.

Concerning their habits, Dr. Andrews writes that while in camp at Loh, June 27 to July 11, the Wild Asses were abundant. At this time they were in pairs, male and female, or more often singly. A mare killed on June 28 contained a fetus almost ready for birth and was accompanied by a stallion that was reluctant to leave her when she was killed. On two occasions a mare was seen accompanied by two colts. At this time all the animals

observed were in excellent condition and very fat. Old stallions often bore scars on their necks from combats with other males. On June 27 they were in fresh summer pelage. Dr. Andrews's camp at Loh was situated not far from a spring on the flat gravel plain, whither the animals frequently came to drink, although at times they can apparently go for considerable periods without water. The plain here is very sparsely covered with low bunches of desert shrubs and short tufts of brown grass on which the asses could often be seen grazing. South of this gravel plateau is the lower plain and the lake, Tsagan Nor. The soil is here more sandy but the vegetation much the same as at Loh. Wild Asses were more numerous here, and although when pursued they will often seek the shelter of the "bad lands" with their ravines and gullies, they seem to prefer more open plains where they can see and avoid their enemies the wolves. During his first two years' work in the Gobi, Dr. Andrews was too late in the season to find large herds, for they break up just at the beginning of the foaling time. In 1925, however, Tsagan Nor was reached somewhat earlier, and herds seen then numbered thousands of individuals, for like the grassland antelopes, they evidently collect in large companies just before the young are born. In one instance he estimated that well over a thousand head were present, feeding in a great depression of the plain. He noticed an interesting association of the Wild Ass with the desert-living gazelle (*G. subgutturosa hillieriana*), for the two are almost invariably found together, and when running a herd of Wild Ass with the automobile, the gazelles would come from all directions to join the race. From the camp, within a few hundred yards of the tents they often saw a single stallion that slept and grazed always accompanied by an antelope, an interesting case of companionship between two different species of mammals. Dr. Andrews found that Wild Asses evinced a great curiosity about the automobile, often stopping to look at the car, then running off and stopping again. When pursued by the car, they would invariably swing around and try to cross in front of its course, a trait common to many birds and mammals. Tests with the speedometer showed that when pushed the animals could make a speed of forty miles an hour for a mile or more, then slowing down to about thirty-five miles. A stallion pursued on the open plain was eventually run down after a chase of twenty-nine miles, during which for sixteen miles he averaged thirty miles an hour! Often the animals were seen standing motionless, apparently resting, for an hour or so at a time, or on other occasions they would lie down on the open plain. Single ones were invariably males, presumably those that had been driven from the herd by the master stallion. Granger saw a stallion herd two mares and their colts together for protection when they saw the car. The pairing season is said by the Mongols of the Koko Nor region to be in September, lasting for about a month.

PLATE XX



Wild Asses (*Equus hemionus hemionus*) in the Gobi, near Tsagan Nor

Specimens examined:—Thirteen, from Tsagan Nor, Outer Mongolia.

513. *Equus przewalskii* Poliakov

PRZEWALSKI'S HORSE; "TARPAN"

Equus przewalskii Poliakov, Proc. Imp. Russian Geogr. Soc., 1881, p. 1, pls. 1, 2 (in Russian); Ann. Mag. Nat.

Hist., ser. 5, vol. 8, pp. 16-26, 1881 (translation into English). Zalsensky, Wiss. Resultate d. v. Przewalski Reisen, vol. 1, Mamm., pt. 2, p. 1, pls. 1-4, 1902.

Equus caballus przewalskii Lydekker, The Field (London), vol. 100, p. 680, 1902; Cat. Ungulate Mamm. Brit. Mus., vol. 5, p. 7, 1916.

Equus hagenbecki Matschie, Naturwiss. Wochenschr., ser. 2, vol. 2, p. 581, 1903.

Equus ferus Antonius, Naturwiss. Wochenschr., ser. 2, vol. 11, p. 516, 1912.

Type specimen:—The original specimen is a skin, No. 1523, and skull, No. 514, in the Zoological Museum of the Academy of Sciences at Leningrad, U.S.S.R. They were secured by Tichonov near Zaisan in the steppe country of eastern Dzungaria, and by him given to Przewalski who happened to be in that region then (about 1880).

Description:—Zalensky (1902) has written an excellent monograph on this species, based on the thirteen specimens in the Zoological Museum of the Academy of Sciences at Leningrad. The following particulars are drawn chiefly from his account. Size small, about the same as that of *E. hemionus*

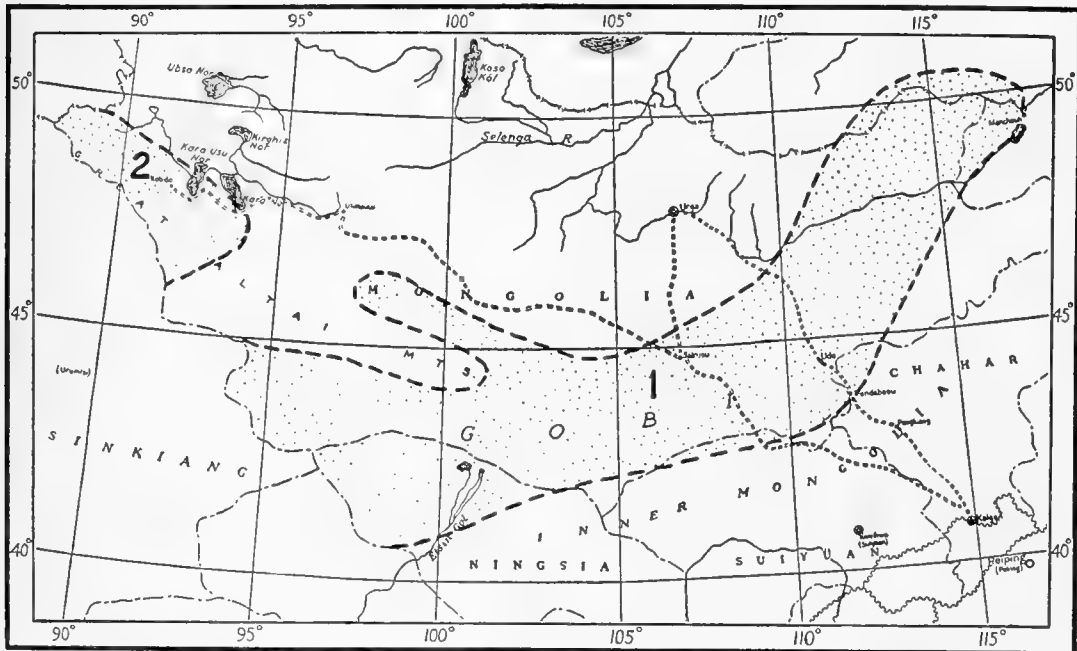


FIG. 75. Distribution Map.

Equus

1. *E. hemionus hemionus*

2. *E. przewalskii*

but the limbs relatively heavier and the head larger in proportion. Forelock very small or absent, the mane short and erect, and the tail long-haired throughout. In winter coat the hair is longer and paler than in summer. The summer coat is pale reddish brown above, paling on the flanks and becoming yellowish white on the belly without sharp line of demarcation. The head is colored like the back, except that the anterior part of the muzzle about the mouth and lips is white. Ears pale brown at base, darker brown at the tips, and white inside.

In winter coat, longer, stiffer hairs develop along the cheeks as a sort of fringe, and are reddish. The lower limbs are darker brown than the body, and there is a narrow median stripe of black on the rump and upper part of the tail. The upper half of the tail is like the back, brown becoming mixed with yellowish in the terminal half. In the summer skins there are from two to five rather indistinct cross-stripes on the legs, but in winter these are not clearly discernible. Zалensky (1902) in his colored plate does not show these, but the adult as there depicted is a nearly uniform dull reddish brown. The immature animals are grayer than adults.

The skull is compared by Zалensky with that of the domestic Ass and appears to be proportionally much longer in the rostral portion, with long and evenly tapering nasals which in the latter are much pinched-in near the base. Also, the combined posterior margins of the nasals are nearly square across in the Ass but divergent in the present species. The same author publishes excellent figures of the teeth and skull, as well as of various bones of the skeleton. He brings out that the width across the orbits is greatest in this species as compared with others of the genus. The teeth are essentially like those of the domestic horse in structure, but smaller.

Measurements:—No external measurements of this horse are at hand.

The following cranial measurements are selected from the comparative table published by Zалensky, and are those of the largest of the adults he lists. Greatest length, 542 mm.; basilar length, 485; greatest width of face, 190; greatest width of forehead, 212; mastoid width, 116; greatest width of brain case, 107; least width of brain case, 91; height of occiput from lower lip of foramen magnum, 105; combined posterior width of nasals, 108; greatest length of nasals, 255; median length of same, 210; length of lower jaw, 426; upper cheek teeth, 183; lower cheek teeth, 186; upper diastema, incisor to premolar, 88; lower diastema, 87.

Bradley (1907) has published comparative craniometrical data on this and other members of the genus, while Noack (1902b) has described four skulls of different ages. Lydekker (1916, pp. 4, 5) figures the skull and upper tooth row.

Nomenclature:—Since its discovery by Przewalski much has been written about this species and a number of opinions held as to its relationship with the domestic horse, ass and wild asses. It is agreed, however, that it is closely related to the first of these, while both Ewart (1903) and Lydekker (1901) regarded it as not the ancestor of the domestic horse. The latter author (1916) decided that it probably once intergraded with the horse of Europe, *E. caballus*, of which he regarded it therefore as a subspecies. While this is not unlikely, it seems now difficult of proof, especially as the two animals do not readily interbreed. For the present it seems best to follow the original describer in giving it specific rank.

Occurrence and Habits:—Przewalski's Horse was first brought to the notice of naturalists by the explorer for whom it was named, who, in the course of his Asiatic journeys, brought back a skin and skull from Dzungaria at the western end of the Gobi, given him by a hunter who secured the specimen near Zaisan. It is found from about the northeastern part of the Tien Shan Range eastward into extreme northeastern Sinkiang and the far western part of Mongolia, and thence westward to near the Zaisan district. About 1900, Hagenbeck's collectors secured a small number alive in the Kobdo basin of Mongolia, and these eventually reached Europe, supplying the London Zoological Gardens, the Duke of Bedford's park, Moscow, and other collections. P. L. Sclater (1902) has described the method of catching the young in western Mongolia and raising them for export. The young are said to be born in late April and the first three weeks of May, the mares resorting to special places where food and water are plentiful. Lydekker (1901) has given a brief account of a drove of twelve colts in the possession of the Duke of Bedford at Woburn Abbey, and other notes have also been published by Noack (1902, 1902b, 1903a). Evidently the range of the species is rather circumscribed in the plains of the Altai region and extreme western Mongolia. It apparently does not extend eastward of the Kobdo basin.

Specimens examined:—None.

CHAPTER XVI

ORDER SIRENIA

SEA-COWS

THE sea-cows stand in somewhat the same relation to the elephants as the whales do to the carnivores, for anatomical evidence points to their derivation as aquatic members of a line closely related to that of the Proboscidea. Like the latter they tend to develop the upper incisors as tusks; their cheek teeth come into place in succession from the back end of the tooth row, pushing the others forward as they wear, instead of coming in from below with the permanent teeth pushing out the milk teeth. In both groups the heart is divided at the apex and the diet is vegetarian. In modern species the hind limbs and the pelvis have disappeared, the fore limbs are made over into a paddle-like form, and the tip of the tail is expanded to broad flukes for propulsion, so that they parallel the whales in many of their adaptations for aquatic life. In the warmer waters of the Atlantic Ocean and of the large rivers flowing into it near the equator, the order is represented by the manatees. In the North Pacific the Steller's Sea-cow (*Hydrodamalis*) was found in limited areas, and became exterminated about 1768, while in tropical and subtropical waters of the Indian Ocean and the western Pacific as far east as Australia, the Dugong is the only living member of this once extensive group.

Family DUGONGIDÆ

DUGONGS

Genus *Dugong* Lacépède

THE DUGONG

Dugong Lacépède, Tableau des Mammifères, p. 17, 1799; and in Buffon, Hist. Nat. des Quadrupèdes, Didot ed., vol. 14, p. 193, 1799. Genotype *Dugong indicus* Desmarest = *Dugong dugon* (P. L. S. Müller).
Halicore Illiger, Prodromus Syst. Mamm. et Avium, p. 140, 1811.

The dugongs differ from the manatees externally in having a median notch between the flukes of the tail. They have small vestiges of nails at the tips of the fore limbs. The upper pair of incisors in males are enlarged

to form tusks, and the tips of both jaws are sharply bent downward instead of being nearly straight. The cheek teeth are five or six in each jaw, more nearly cylindrical and with little distinction between crown and root as compared with those of manatees. The number of distinct forms is still somewhat doubtful, but at most there are not more than two or three, perhaps only one species, with one or two local races.

514. *Dugong dugon* (P. L. S. Müller)

Tricheus dugon P. L. S. Müller, Linné's Vollständigen Natursystems, Suppl., p. 21, 1776. "Vorgeborge der Guten Hofnung an, bis an philippinischen Inseln."

Description.—Form somewhat like that of a whale, with tapering after portion of the body terminating in lateral flukes deeply notched in the middle. Head but little marked off from trunk. Rostrum with wide flattened plate-like lips. Upper incisors one on each side, cheek teeth five or six. Skin with few scattered bristles.

Measurements.—Length upwards of eight feet.

Occurrence and Habits.—I know of no recent records of the Dugong in the coastal waters of China, but its occasional presence is to be looked for in the seas bordering South China. It is well known in the Philippine archipelago, and perhaps follows along these islands somewhat to the northward, for Hirasaka (1932) has published an account of the capture of three on the coast of Formosa in the early part of 1931. The first was taken at Tai-ju-bo on the west side, January 18 of that year, while in the following June, two males, a young and an adult, were captured at Koshum. The same author states that "many decades" ago they were common among the Riu Kiu Islands, where they were regularly pursued for their flesh and oil. In a brief note in the China Journal (G. M. Allen, 1935), I lately called attention to the account of the Dugong in the French edition of de Goyer and de Keyser's "L'Ambassade de la Compagnie Orientale des Provinces Unies vers l'Empereur de la Chine," 1665. These travelers landed at Canton in 1655, and although their experience with the Dugong may have pertained to the East Indies, it is not impossible that they knew of its presence in the seas of South China, as their relation implies.

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